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THE UNIVERSITY OF ALBERTA

THE DEMAND FOR COTTON IN THE UNITED STATES

by

© FULGENTIO KAGODO SABAVUMA SERUNJOGI

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

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THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "The Demand for Cotton in the United States" submitted by Fulgentio Kagodo Sabavuma Serunjogi in partial fulfilment of the requirements for the degree of Master of Science.

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ABSTRACT

This study analyses the demand for cotton in the United States in relation to the other major textile fibres, namely wool, cellulosics and non-cellulosics, for the period 1947 to 1969. It also provides a general discussion of international trends in the production, consumption and trade in these fibres and the implications of these trends for the cotton producing countries. Special attention has been directed toward the increase observed since the mid-fifties in the production and consumption of non-cellulosic fibres in many developed countries. These countries originally provided markets for cotton from developing countries.

Econometric analyses were applied to both annual and quarterly data to analyse the effects of the levels of fibre prices, income and population on the consumption of cotton in the United States. The analysis of annual data covered the periods 1947 to 1969 and 1956 to 1969. The choice of the latter period was based on the observed importance of non-cellulosic fibres in the total fibre market during this period. The analysis of quarterly data was from 1954 to 1967. The analysis used linear and double-logarithmic formulations of single-equation multiple regression models.

The results of the analysis of both annual and quarterly data suggest that cotton consumption is fairly responsive to income changes and is adversely affected by income increases. Cotton, therefore, appears to be an "inferior good". With respect to changes in its own price, cotton consumption is considerably more elastic in the long-run than in the short-run; however, it is own-price inelastic in both cases.

The analysis of annual data for the period 1956 to 1969 indicates that cotton and non-cellulosic fibres are complements. This feature confirms the observed importance of cotton and polyester or nylon blends in the apparel and household furnishings end-uses. Results from the analysis of quarterly data indicate that there are significant seasonal demand shifts in the consumption of cotton in the United States with consumption being highest in the first quarter and lowest in the third.

The feature that cotton is an inferior good implies that cotton growing countries have to change their production policy. The relevance of support programmes should be re-examined if over-production is to be avoided. In addition, trade policies of importing countries should be revised to allow a freer movement of commodities, especially processed goods. However, the feature that cotton and non-cellulosic fibres are complements implies that research

in cotton processing for blends is of paramount importance. Research should be carried out in new and existing end-uses. These efforts should be complemented by promotion to reduce the inferior nature of cotton.

Results from the analysis of annual data for the period 1956 to 1969 indicate that studies based on more recent data give relatively more realistic conclusions than those based on earlier data. Further studies should, therefore, develop and use more recent data particularly in the analysis of the effect of non-cellulosic fibres on the demand for cotton.

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CHAPTER I

INTRODUCTION

The Problem

In the major cotton consuming areas of the United States, Western Europe, Japan and the Far East, the cotton industry has been facing severe competition from substantial increases in the production and consumption of synthetic fibres. This competition has occurred since the late 1940's and has been particularly evident since the mid-fifties when non-cellulosic fibres[1] started to make increasing gains in many end-use markets originally dominated by cotton.

Although cotton accounted for over 50 percent of the total world textile fibre production in 1974, its share of world production had declined by 23.4 percent over the period from 1951 to 1974.[2] Synthetics, on the

---

[1] Cellulosic fibres are those fibres made by dissolving and resolidifying natural cellulose by a chemical process. The most common are rayon and acetate. Non-cellulosic fibres are those fibres manufactured from polymer chemicals generally found in coal, oil and petroleum. The most common are acrylic, nylon and polyester.

[2] Statistics are taken from Textile Economics Bureau, Textile Organon (New York: Textile Economics Bureau, various issues).

other hand, had increased to 40 percent of the total world textile fibre production by 1974, an increase of 24.9 percent over the period from 1951 to 1974. Most of this increase was made up of non-cellulosic fibres. These fibres rose from only 0.9 percent to 27 percent of total world fibre production over the period from 1951 to 1974. The relative world per caput consumption of cotton fell from 65 percent in 1961 to 51 percent of the total fibre use in 1971.[1] In contrast, the per caput consumption of synthetic fibres accounted for 22 percent in 1961 and 40 percent of the world per caput fibre use in 1971. The bulk of this increase was accounted for by non-cellulosic fibres whose world per caput consumption rose from 4 percent in 1961 to 25 percent in 1971.

This study focuses on the competition against cotton from other fibres, particularly from the non-cellulosics, in the United States. The study is based on United States data because that country is not only a major producer and exporter of cotton but is also one of the major cotton consuming countries of the world. Therefore, the United States constitutes a significant market for cotton. The United States is also one of the world's major synthetic fibre producing and consuming countries. The trends in the consumption of textile fibres in the United States and

---

[1] Bureau of Agricultural Economics, The Fibre Review 1971-72 (Canberra, Australia: Australian Government Publishing Service, 1972), Table III.2, p. 106.

the trade policies of that country are, to some extent, representative of the trends and policies in other developed countries.

The Objectives

The principal objectives of this study are:

1. To describe the trends in the world production and consumption of cotton in relation to the other major textile fibres, namely wool, cellulosic and non-cellulosic fibres, for the period from 1951 to 1974.
2. To outline the world trends in trade and to outline certain major factors that affect the trade in cotton and cotton products.
3. To estimate the effect of changes in prices, income and population levels on the consumption of cotton in the United States using econometric methods.
4. To use the estimated parameters to calculate the price and income elasticities of demand for cotton in the United States.
5. To investigate the apparent blending relationship that applies for cotton and non-cellulosic fibres and to assess the effect that this feature may have on the future consumption of cotton in the United States.

The Hypotheses

The hypotheses tested in the analysis of the demand for cotton in the United States are:

1. That the consumption of cotton is inversely related to changes in the price of cotton.
2. That the consumption of cotton is directly related to changes in consumer incomes.
3. That the consumption of cotton is directly related to changes in the prices of the other major textile fibres.
4. That the consumption of cotton is influenced by seasonal changes in the demand for consumer textile goods.
5. That the consumption of cotton is own-price elastic in the long-run.

The Methodology

The long term demand function for consumer goods is dependent on such factors as the level of population and its characteristics, the amount of disposable income, the level of prices, the availability of substitutes and their relative prices, and other factors such as tastes and preferences. These factors, in turn, depend on such features as the birth rate and the immigration policy of a country, the level of economic activity, and international elements which affect price levels within the marketing system.

This study analyses the mill demand for cotton, in terms of per caput consumption, in relation to prices of the other major textile fibres and the level of disposable income in the United States. A single-equation multiple regression analysis is used in this study. The estimated parameters are used to calculate price and income elasticities of demand over both short-run and long-run time periods. Annual data are used to estimate long-run elasticities of demand. Quarterly data are used to calculate short-run elasticities of demand and to test for the possibility of seasonal shifts in the demand for cotton which would not be reflected in the analysis of annual data.

Chapter II gives a general description of world trends in the production and consumption of cotton and of trade in cotton fibres and compares these trends with those for the other major textile fibres. Chapter III discusses the demand for textile fibres as being derived from the demand for final textile consumer products. This chapter also reviews some of the recent studies of the demand for textile fibres in the United States and outlines the models and data that were used in this study. Chapter IV presents the results of the analysis of the demand for cotton in the United States. Finally, Chapter V provides a summary of the study, and outlines the conclusions and recommendations that may be drawn from the study.

CHAPTER II

THE WORLD COTTON ECONOMY

Introduction

Until the early 1950's, cotton was the major textile fibre. Next in importance was wool, followed by silk. Since then, the position of cotton has been challenged by the production and use of synthetic fibres, first by cellulosic fibres and, since the mid-fifties, by non-cellulosic fibres. Currently the volume of cotton produced is larger than that of any other individual fibre. However, synthetic fibres are now predominantly consumed in many end-use markets which were previously dominated by cotton. This replacement of cotton by synthetics, especially by non-cellulosic fibres, can be clearly seen in apparel, household furnishings and industrial end-uses.

This chapter discusses the major trends in the production, supply and consumption of cotton as compared to other fibres. In addition, trends in trade and possible effects of tariffs on trade will be discussed in view of the claims by developing countries that they are forced to depend on the export of raw materials rather than semi-manufactured and finished products.

World Cotton Production and Supply

Over the period from 1950 to 1974, cotton accounted for over 50 percent of the total world production of major textile fibres. The contribution of cotton to total fibre production averaged 72.9 percent over the period from 1950 to 1954 but declined to just over 50 percent by 1974 (see Table 2.1). The most obvious reason for this relative decline has been the tremendous increase in both the production and mill use of synthetic fibres, particularly of non-cellulosic fibres. The production of non-cellulosic fibres rose from an average of 324 million pounds (or 1.2 percent of total world fibre production) over the period from 1950 to 1954 to 16,115 million pounds (27 percent) in 1974. A related factor in the relative decline in the production and consumption of cotton may have been the instability of both production and prices for cotton which characterized this period. This has been in contrast to the more stable production and prices of synthetic fibres (see Tables 2.3 and 3.4). Fluctuations in the production and prices of cotton have basically been caused by variable growing conditions, pests and disease. These were instrumental in the small crops experienced in the United States, Mexico and other countries in the 1967, 1968 and 1970 seasons.[1]

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[1] Commonwealth Secretariat, Wool Intelligence, Vol. 28, No. 8 (August, 1975), p. 544.

TABLE 2.1

WORLD PRODUCTION OF MAJOR TEXTILE FIBRES, 1950-1974

	Cotton*	Wool*	Cellulosics	Non-Cellulosics	Cotton	Wool	Cellulosics	Non-Cellulosics	Natural	Manmade
	Million Pounds				Percentages					
Average 1950-1954	19323	2846	4042	324	72.9	10.6	15.2	1.2	83.5	16.4
Average 1955-1959	21054	5208	5257	872	65.0	16.1	16.2	2.7	81.1	18.9
Average 1960-1964	23368	5672	6378	2260	62.1	15.1	16.9	5.9	77.2	22.8
1965	25457	5729	7331	4150	59.7	13.4	17.2	9.7	73.1	26.8
1966	26248	5853	7359	4982	59.1	13.2	16.6	11.2	72.3	27.7
1967	24058	5994	7269	5749	55.9	13.9	16.9	13.3	69.8	30.2
1968	26050	6175	7780	7613	54.7	13.0	16.3	16.0	67.7	32.3
1969	26179	6131	7835	8905	53.4	12.5	16.0	18.2	65.9	34.1
1970	25060	6063	7565	10025	51.4	12.4	15.5	20.6	63.8	36.2
1971	27363	5928	7613	12006	51.7	11.2	14.4	22.7	62.9	37.1
1972	28508	5532	7833	13680	51.3	10.0	14.1	24.6	61.3	38.7
1973	28649	5366	8083	16359	49.0	9.2	13.8	28.0	58.2	41.8
1974	30110	5730	7734	16115	50.4	9.6	13.0	27.0	60.0	40.0

* Figures apply to the 12 month period from August 1 to July 31.

SOURCE: Textile Organon, Textile Economics Bureau, New York (Various Issues).

Major Cotton Producing Countries

The major cotton producing countries are the United States, the Soviet Union, China and India, in that order (see Table 2.2). Between them, these four countries account for at least 50 percent of the annual world cotton production. The remaining 50 percent is produced mainly by developing countries, the major producers being Egypt, Sudan and Pakistan. Including India, the developing countries account for just over 60 percent of the world production of cotton.

There are a large number of developing countries that grow cotton, especially in Africa, Asia and South America, with each country growing just a small portion of the world crop. In addition, most of these countries are more or less in the same latitude and, therefore, tend to grow the same type of cotton. The United States, however, produces cotton of varied staple lengths, ranging from short to extra long staples. This feature allows that country to compete more favourably in a wide range of cotton end-use markets as compared to developing countries.

In contrast to cotton, wool and synthetic fibres are largely produced in developed countries (see Table 2.2). The production of wool is dominated by Australia, New Zealand, China and Eastern Europe, while synthetics are mainly produced in Western Europe, the United States and Eastern Europe.

TABLE 2.2

WORLD PRODUCTION OF MAJOR FIBRES BY REGION, 1960-1974

Fibre and Region	Average 1960-1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
						Million Pounds					
COTTON*											
Egypt	960	1116	1153	1007	967	966	1199	1126	1128	1137	1084
Sudan	320	336	362	427	432	504	545	542	540	442	521
Other Africa	659	786	848	971	886	1172	1320	1110	1203	1209	1173
China	2688	3072	3408	3696	3984	3696	3552	3744	3648	3120	4752
India	2138	2362	2208	2208	2544	2352	2328	2112	2784	2578	2654
Pakistan	760	842	924	1032	1152	1171	1193	1234	1567	1553	1459
Other Asia & Oceania	1195	1640	1737	1709	1754	2045	1926	1848	2193	2378	2263
Soviet Union	3530	4034	4332	4620	4560	4464	4289	5232	5323	5520	5810
Western Europe	394	336	360	404	369	345	390	376	364	440	348
Brazil	1029	996	1200	984	1320	1594	1488	1104	1488	1416	1248
Mexico	984	1145	1255	1075	960	1176	840	691	823	854	720
United States	7076	7318	7162	4733	3463	5294	4776	4928	4920	6667	6384
Other America	1629	1474	1292	1192	3650	1400	1214	3315	2517	1335	1694
The World	23368	25457	26248	24058	26050	26179	25060	27363	28508	28649	30110
WOOL*											
Australia	1713	1663	1762	1770	1949	2035	1953	1929	1625	1528	1713
New Zealand	607	695	709	728	732	723	736	710	681	613	661
Argentina	413	430	441	494	461	445	441	417	390	397	406
United States	295	241	236	227	211	194	187	181	172	159	150
E. Europe & China	1132	1138	1178	1239	1292	1235	1299	1323	1307	1329	1400
All Others	1512	1562	1527	1536	1530	1499	1447	1368	1359	1340	1400
The World	5672	5729	5853	5994	6175	6131	6063	5928	5532	5366	5730

* Figures apply to the 12 month period from August 1 to July 31.

TABLE 2.2 (CONTINUED)

Fibre and Region	Average 1960-1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
						Million Pounds					
RAYON AND ACETATE											
Western Europe	2155	2599	2478	2355	2506	2557	2420	2346	2312	2382	2195
Eastern Europe	1270	1545	1684	1772	1875	1891	1967	2060	2221	2367	2517
North & South America	1544	1882	1859	1729	1959	1919	1689	1748	1765	1751	1553
All Others	1408	1305	1338	1413	1440	1468	1489	1459	1535	1583	1469
The World	6378	7331	7359	7269	7780	7835	7565	7613	7833	8083	7734
ACRYLIC											
Western Europe	111	275	348	413	594	741	880	1051	1150	1437	1296
Eastern Europe	18	51	73	84	97	108	164	198	233	296	344
North & South America	195	378	365	408	543	562	535	603	701	847	765
All Others	75	187	222	288	377	458	634	725	711	873	788
The World	401	891	1008	1193	1611	1869	2213	2577	2795	3453	3193
NYLON											
Western Europe	446	689	845	909	1170	1328	1321	1486	1591	1782	1656
Eastern Europe	91	197	237	282	321	370	400	463	523	560	610
United States	607	936	1066	1051	1350	1411	1355	1595	1975	2175	2126
Other America	60	132	159	177	212	233	258	287	320	367	350
All Others	178	298	369	478	566	698	860	920	946	1072	975
The World	1383	2252	2676	2897	3619	4040	4194	4751	5355	5956	5717
POLYESTER											
Western Europe	176	333	426	471	689	871	1010	1292	1437	1799	1726
Eastern Europe	10	35	47	66	83	138	197	265	320	426	586
North & South America	176	416	546	771	1178	1437	1632	2056	2653	3314	3412
All Others	112	223	279	351	433	590	780	1065	1120	1411	1481
The World	475	1007	1298	1659	2383	2996	3618	4678	5530	6950	7205

SOURCE: Textile Economics Bureau, Textile Organon (New York, Textile Economics Bureau, Various Issues).

TABLE 2.3

AVERAGE ANNUAL COTTON PRICES, UNITED STATES AND ENGLAND
(C.I.F. Liverpool) 1955-1972

	Middling 1 Inch		Strict Middling 1 1/16 Inch		Strict Middling 1 1/8 Inch	
Year	U.S.A.	England*	U.S.A.	England**	U.S.A.	England***
			(U.S. Cents Per Pound)			
1955	38.91	36.91	40.99	33.04	42.74	43.07
1956	33.17	34.47	35.76	34.54	37.18	44.41
1957	30.62	34.55	34.46	33.15	36.75	41.44
1958	30.48	33.06	34.88	32.29	36.34	35.75
1959	26.92	29.20	30.49	28.57	31.72	33.56
1960	27.03	31.66	29.83	30.08	31.05	38.44
1961	28.81	32.26	30.78	30.66	32.23	36.46
1962	28.62	32.35	30.55	30.28	32.00	35.03
1963	27.29	28.66	29.54	29.46	31.36	35.11
1964	26.96	27.82	29.37	29.87	31.35	37.22
1965	26.75	29.70	29.31	28.78	31.39	35.63
1966	25.40	27.30	28.05	28.28	30.80	31.60
1967	25.71	26.02	30.40	29.89	30.43	33.80
1968	28.22	28.28	33.07	32.00	34.85	37.74
1969	25.53	27.15	28.47	28.52	29.97	33.55
1970	27.46	29.61	29.67	29.20	31.32	33.15
1971	32.64	33.25	34.21	34.47	35.32	39.49
1972	34.66	32.63	36.55	37.66	37.42	39.89

* Average price for the Pakistan 289 F variety.

** Average price for the Iranian SM 1 1/6 inch variety.

*** Average price of the Uganda BP 52 variety.

SOURCE: U.S.D.A., Statistics on Cotton and Related Data 1920-73, Statistical Bulletin No. 535 (Washington, D.C.: U.S.D.A., E.R.S., 1974).

World Cotton Stocks

World cotton supplies are derived from two sources: the current year's crop and the carry over from previous years. It should be noted that if stocks are excluded, annual cotton production more or less just covers annual mill consumption (see Table 2.4). However, stocks have consistently amounted to over 25 percent of the annual aggregate cotton supply.

Until 1967, the United States accounted for over 50 percent of world stocks. However, after the relatively small crop in 1968, that country's stocks fell. Stocks had decreased by almost 75 percent to just over three million bales by 1972. Stocks held by other countries have been steadily increasing, rising from an average of 17 million bales over the period from 1950 to 1954, to 20 million bales in 1972. This situation can partly be accounted for by the declining use of cotton due to the competition from synthetic fibres. Other likely causes of large stocks are support policies for cotton carried out by some countries such as the United States and Pakistan. In addition, there are few profitable alternative crops in many of the developing countries. Such countries may continue to maintain or even expand cotton growing even when economic conditions are adverse.

Therefore, in spite of stock reductions in the United States and generally adverse growing conditions in some parts of the world during the latter part of the 1960's,

TABLE 2.4

WORLD SUPPLY AND MILL CONSUMPTION OF COTTON, 1950-1972*

Year	Supply					Mill Consumption		
		Carry Over, August 1						
	World Production	U.S.A.	Other Countries	World	Total Supply	U.S.A.	Other Countries	World
	(Thousand Bales**)							
Average 1950-1954	40374	5100	11883	16983	57357	9018	28668	37686
Average 1955-1959	43913	10821	11848	22669	66782	8707	35511	44218
Average 1960-1964	48770	9242	12730	21972	70743	8686	38632	47319
1965	54683	14291	13995	28286	82969	9497	42485	51982
1966	50121	16862	14376	31238	81359	9485	43999	53484
1967	49032	12533	15142	27675	76707	8982	44802	53784
1968	54539	6448	16476	22924	77463	8242	45650	53892
1969	52316	6521	17158	23679	75995	7991	46332	54323
1970	52471	5760	16038	21798	74269	8068	46754	54822
1971	57008	4252	15533	19785	76793	8039	48054	56093
1972	59758	3325	16920	20245	80003	7800	49379	57179

* Figures apply to the 12 month period from August 1 to July 31.

** 480 pounds net weight bales.

SOURCE: U.S.D.A., Statistics on Cotton and Related Data, 1920-1972, Statistical Bulletin No. 535 (Washington, D.C.: U.S.D.A., E.R.S., 1974).

aggregate world cotton supplies rose from an annual average of 57 million bales over the period from 1950 to 1954 to 80 million bales in 1972. However, world cotton consumption rose only to 57 million bales in 1972 from an annual average of 37 million bales over the period from 1950 to 1954.

World Cotton Consumption

Aggregate world mill consumption of cotton has shown a slight upward trend over the period from 1950 to 1972 (see Table 2.4). Consumption rose from an annual average of 37 million bales between 1950 to 1954 to 57 million bales in 1972. Table 2.4 shows that the largest increase has been in the "other countries" whose consumption almost doubled over the period from 1950 to 1972. This increase has been in part a result of steadily rising consumption in China and the Soviet Union, and Japan (see Table 2.5). In addition, developing countries have shown increased consumption, particularly of locally grown cotton. These countries include Tanzania, Colombia, Argentina and Pakistan. Increased consumption has resulted from their efforts to reduce depletion of their foreign exchange by substituting for the importation of foreign textile products and to increase export earnings from higher valued manufactured and finished textile goods.

The consumption of cotton in the United States has

TABLE 2.5

WORLD COTTON CONSUMPTION

Country \ Year	1970-71	1971-72	1972-73	1973-74	1974-75
			(Million Kg)		
United States	1749	1743	1691	1626	1263
Western Europe	1404	1403	1393	1404	1344
India	1127	1193	1236	1288	1279
Japan	768	784	807	802	650
Sino-Soviet Countries	4496	4655	4734	4886	5035
Other Countries	2658	2763	3008	3298	3100
World Total	12202	12541	12869	13304	12667

SOURCE: The Commonwealth Secretariat, Wool Intelligence, Vol. 28, No. 8 (August, 1975), p. 546.

varied very slightly over time but has declined since the record level of consumption of 4,477.5 million pounds in 1965 (Table 2.6).

The observed declines have been attributed partly to the world-wide recession during the late 1960's and early 1970's. This recession caused textile mills in Western Europe, the United States, Japan and some countries of the Far East to be "squeezed between tight and expensive credit, rising costs of production and no prospects of any real improvement in textile demand in the short term."[1]

The major reason for the long-run relative decline in the consumption of cotton, however, appears to be the ever increasing competition from synthetic fibres. Due to their qualities of strength, adaptability and price stability, synthetic fibres have been accepted in many end-use markets which were originally dominated by cotton. This substitution has applied particularly in the cases of industrial uses, household furnishings and women's apparel (see Table 2.13). Such competition has almost completely displaced or reduced cotton to a blending category and has led to a considerable reduction in the consumption of cotton in these end-uses. This trend for the United States can be seen from figures on the market share

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[1] Commonwealth Secretariat, Wool Intelligence, Vol. 28, No. 8 (August, 1975), p. 545.

TABLE 2.6

UNITED STATES FIBRE MILL CONSUMPTION AND FIBRE MARKET SHARES, 1947-1970

	Mill Consumption					Market Shares			
Year	Cotton	Wool	Cellulosics	Non-Cellulosics	Total	Cotton	Wool	Cellulosics	Non-Cellulosics
	Million Pounds*					Percentage			
1947	4665.6	384.0	1403.6	88.1	6541.3	71.3	5.9	21.5	1.3
1948	4463.5	381.2	1631.6	122.6	6598.9	67.6	5.8	24.7	1.9
1949	3839.1	275.2	1437.4	160.1	5711.8	67.2	4.8	25.2	2.8
1950	4682.7	349.1	1900.8	238.8	7171.4	65.3	4.9	26.5	3.3
1951	4868.6	266.3	1781.4	331.8	7248.1	67.2	3.6	24.0	4.6
1952	4470.9	256.5	1715.0	422.4	6864.8	65.1	3.7	25.0	6.2
1953	4456.1	271.6	1734.7	485.5	6947.9	64.1	3.9	25.0	7.0
1954	4127.3	211.3	1609.8	576.0	6524.4	63.3	3.2	24.7	8.8
1955	4382.4	227.6	1995.5	761.0	7366.5	59.5	3.1	27.1	10.3
1956	4362.6	242.4	1698.2	857.2	7160.4	60.9	3.4	23.7	12.0
1957	4060.4	202.8	1657.2	1017.8	6938.2	58.5	2.9	23.9	14.7
1958	3866.9	182.1	1579.7	1035.7	6664.4	58.0	2.7	23.7	15.6
1959	4334.5	236.1	1765.5	1335.1	7671.2	56.5	3.1	23.0	17.4
1960	4190.9	226.1	1489.8	1385.5	7292.3	57.5	3.1	20.4	19.0
1961	4081.5	226.7	1564.4	1559.3	7431.9	54.9	3.1	21.0	21.0
1962	4188.0	236.0	1731.4	1937.2	8092.6	51.8	2.9	21.4	23.9
1963	4040.2	226.4	1930.3	2235.3	8432.2	47.9	2.7	22.9	26.5
1964	4244.4	196.2	2053.4	2741.6	9235.6	46.0	2.1	22.2	29.7
1965	4477.5	212.9	2097.5	3390.5	10178.4	44.0	2.1	20.6	33.3
1966	4630.5	203.6	2134.6	3990.8	10959.5	42.3	1.8	19.5	36.4
1967	4423.0	171.9	1999.2	4472.2	11066.3	40.0	1.5	18.1	40.4
1968	4146.5	181.3	2236.3	5875.4	12439.5	33.3	1.5	18.0	47.2
1969	3932.8	172.0	2124.6	6453.9	12683.3	31.0	1.4	16.7	50.9

* All pounds are cotton equivalents.

SOURCE: U.S.D.A., Cotton Situation (Washington, D.C.: U.S.D.A. Economic Research Service, Various Issues).

in Table 2.6.

World Cotton Trade

In spite of the fact that world consumption of cotton has shown only a modest increase over the period from 1950 to 1972, both the volume and value of world trade increased substantially over this period. World trade in cotton amounted to an annual average of 3.7 million metric tons[1] valued at over 2,306 million dollars over the period from 1960 to 1964, and rose to 4.6 million tonnes valued at 4,126 million dollars in 1973. This increase in trade has been partly due to the fact that a number of major cotton consuming countries grow little or no cotton. China, the Soviet Union and the United States are exceptions. Further, because of differences in staple lengths and in end-uses, even major cotton producing countries such as China, India and the Soviet Union import large amounts of cotton. These three countries are actually net importers of cotton (see Tables 2.7 to 2.10).

Major Cotton Importing Countries

The major cotton importing areas are Western Europe, Japan, China, the Soviet Union and India (see Table 2.7). The most recent spectacular increase in cotton imports

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[1] In the following pages metric tons are referred to as "tonnes".

TABLE 2.7

RAW COTTON IMPORTS BY MAJOR IMPORTING COUNTRIES, 1960-1973

Importer	Annual Average 1960-1964	Annual Average 1965-1969	1970	1971	1972	1973
			(Metric Tons)			
Europe	2050168	1990678	1960930	1822900	1858110	2100140
European Community	1004858	912954	860230	761790	714631	849698
United Kingdom	240394	190916	166680	142180	136857	170848
Soviet Union	171080	161480	257700	242700	166600	130700
North & South America	176878	190086	147830	172070	176097	159644
Canada	85664	88804	68710	81460	76713	78247
United States	30510	22136	8110	8310	16055	7258
South America	47768	59822	50890	61470	62579	51488
Other America	12936	19324	30120	20830	20750	21651
Asia	1233742	1220518	1582200	1619880	1691635	2137179
China	186176	174468	194040	220310	303000	555000
India	163302	119224	136390	155930	129834	100000
Japan	699694	827844	768720	754070	802118	855067
Africa	35170	58234	63860	66710	70919	76471
Australia	19990	13346	4710	7000	8939	3900
The World	3687244	3834744	4017230	3931250	3972300	4608034

SOURCE: U.N., F.A.O. Trade Yearbook, Vols. 18-28 (Rome: Food and Agriculture Organization of the United Nations, 1964-1974).

TABLE 2.8

VALUE OF COTTON IMPORTS BY MAJOR IMPORTING COUNTRIES, 1960-1973

Importer	Annual Average 1960-1964	Annual Average 1965-1969	1970	1971	1972	1973
			(Thousand Dollars)			
Europe	1407830	1333030	1303990	1317810	1530950	1977920
E.E.C.	610010	569690	527440	525780	596650	831800
United Kingdom	158550	119010	104740	100110	11018	16267
Soviet Union	14730	136600	249630	252690	18368	200080
North & South America	119480	125440	93380	12023	13667	145200
Canada	50370	49300	3602	4548	5285	6518
United States	24800	17150	6290	6570	11960	6380
South America	3678	44910	38870	49530	54720	53810
Others	8730	12510	14560	16130	17140	19830
Asia	802130	864060	969590	1108350	1301680	1770420
China	84070	99370	104260	131250	204240	422330
India	126620	106170	12726	150000	135690	144070
Japan	434870	43913	461360	514310	610030	695540
Africa	19520	31510	36230	40370	53930	79100
Australia	13220	8660	3360	4830	6800	3420
The World	2506500	2494230	2672370	2850950	3213800	4176230

SOURCE: U.N., F.A.O. Trade Yearbook, Vols. 18-28 (Rome: Food and Agriculture Organization of the United Nations, 1964-1974).

has been by China. That country's imports of cotton increased from an annual average of 186,176 tonnes valued at an average of 84 million dollars over the period from 1960 to 1964, to 555,000 tonnes valued at over 422 million dollars in 1973. This represents an increase of 368,824 tonnes over the period from 1960 to 1973.

Imports by Japan rose from an annual average of 699,694 tonnes over the period from 1960 to 1964, to 855,067 tonnes in 1973. These imports represent an average annual value of 435 million dollars over the period from 1960 to 1964, and amounted to 696 million dollars in 1973. Another major cotton importing area is the European Community. However, imports by this area have dropped from an annual average of 1,004,858 tonnes over the period from 1960 to 1964, to 849,698 tonnes in 1973. This may be a reflection of the effects of the recession on the textile industry in Western Europe and the penetration of the textile market by synthetics. Imports of cotton by the Soviet Union also dropped from an annual average of 171,080 tonnes over the period from 1960 to 1964 to 130,700 tonnes in 1973.

Major Cotton Exporting Countries

With the exception of India, all major cotton importing countries are developed nations. Even the imports to Africa are mainly to South Africa. The export situation is different. The United States and the Soviet Union domin-

TABLE 2.9

RAW COTTON EXPORTS BY MAJOR EXPORTING COUNTRIES, 1960-1973

Exporter	Annual Average 1960-1964	Annual Average 1965-1969	1970	1971	1972	1973
			(Metric Tons)			
Europe	76664	100076	98300	99470	74594	91298
Soviet Union	386440	501320	516500	546800	652200	728300
North & South America	2094448	1789876	1600390	1574780	1537587	2094755
United States	1041650	799772	676280	898710	701160	1246407
Mexico	347650	379022	213776	166136	203989	178635
South America	358924	398860	546950	334000	396664	415476
Other America	338324	212222	163384	175940	235774	254237
Asia	498054	639132	743650	777190	867555	837420
India	50678	35997	11127	31873	64845	50000
Iran	56944	79153	100000	102401	115556	100000
Pakistan	102202	144196	135100	192000	260116	196809
Syria	115556	124690	135964	118974	116416	119168
Other Asia	172674	253096	362459	331942	310622	371443
Africa	688958	770872	934900	952150	920207	851159
Egypt	300134	298100	285250	333391	294977	256302
Sudan	132890	134959	229996	239164	246594	232000
Uganda	56008	65081	78117	68753	66584	64692
The World	3724560	3801982	3905280	3957800	4054564	4613732

SOURCE: U.N., F.A.O. Trade Yearbook, Vols. 18-28 (Rome: Food and Agriculture Organization of the United Nations, 1964-1974).

TABLE 2.10

VALUE OF COTTON EXPORTS BY MAJOR EXPORTING COUNTRIES, 1960-1973

Exporter	Annual Average 1960-1964	Annual Average 1965-1969	1970	1971	1972	1973
			(Thousand Dollars)			
Europe	47900	62960	59230	68730	59910	110000
Soviet Union	274520	360620	372040	399850	528820	632040
North & South America	1279950	1060560	973280	1128950	1215460	1751740
Central America	211350	269240	208560	213460	288820	313910
Mexico	131350	146360	123730	117610	147920	165950
South America	206440	218030	269590	214400	275550	342620
United States	730810	426930	371400	583480	503170	929260
Asia	281780	360590	419670	458970	622620	745540
India	23960	18180	5690	21610	51330	26700
Iran	30610	40850	56050	67090	77950	151060
Pakistan	49460	76490	76650	65000	167700	110860
Syria	71340	74930	81110	82390	86380	113180
Turkey	66210	120260	170710	190560	203200	300900
Africa	551560	609990	777860	853590	852470	1037810
Egypt	288340	304510	340100	402470	372510	483560
Sudan	106670	117630	185880	198140	212120	229400
Uganda	39250	41770	49140	49290	51900	47800
The World	2306180	2308850	2484080	2796330	3133130	4125930

SOURCE: U.N., F.A.O. Trade Yearbook, Vols. 18-28 (Rome: Food and Agriculture Organization of the United Nations, 1964-1974).

ate the export market. These two countries account for about 40 percent of the total world exports of raw cotton (see Table 2.9). The remaining 60 percent is shared by the other cotton growing countries of Asia, Africa and South America. Most of these countries are developing nations. Of this group, the major exporting countries are Egypt, Sudan, Pakistan and Syria.

A number of developing countries have moved from exporting cotton in its raw form to exporting manufactured and finished textile products, a market that was formerly dominated by developed countries. This tendency is seen in Hong Kong, South Korea, Taiwan, Colombia and, recently, some countries in Africa. This move has resulted from efforts by these countries to lessen their dependence on exports of raw materials to both increase their foreign exchange earnings and to avoid foreign exchange depletion in importing the relatively more expensive finished products.

Most of the textile products produced by developing countries are relatively cheap and have been imported mainly by Western Europe and North America, especially the United States. The price advantage of these products has caused importing countries to protect their local industries by such measures as import quotas and tariffs. Therefore, the cotton exporting countries have not only had to contend with increased competition from synthetic fibres but also with trade barriers which have restricted

the sale of their products. This feature is not peculiar to textile products but is particularly evident for these products.

Such a situation is not in accord with the principle of comparative advantage and has undesirable effects on both the volume of trade and the economies of developing countries. Further, tariff rates are generally constructed in such a way that the higher the level of processing, the greater the rate that will be applied. The United States' tariff schedules in 1967 and 1975 for some cotton textile products clearly show this feature (see Table 2.11). This feature tends to continue the dependence of developing countries on exports of raw materials instead of manufactured goods.

The Effective Rates of Protection

That the structure of tariffs tends to continue the dependence of developing countries on the export of raw materials has been criticised by developing countries. These countries claim that the nominal tariff rates applying to imports give an inaccurate indication of the extent to which the tariff structure of a country protects the value added in a local industry. Many authors, including

TABLE 2.11

THE UNITED STATES NOMINAL TARIFF RATES
1967 AND 1975

Tariff Number	Item	1967	1975
		(Percentages)	
300.45	Raw cotton, linters and waste	N.A.	5
301.40	Yarns, singles	3.6¢/lb+ 13.5	3.6¢/lb+ 9.64
302.00	Yarns, plied	5¢/lb+ 10	4¢/lb+ 8
320.03	Duck and allied fabrics	8.25	6.28
320.26	Poplin and broadcloth	14	10.65
320.34	Printcloth	16	12.17
320.38	Sheeting	17	12.93
320.48	Shirting, jaquard and dobby	19.5	14.83
320.58	Twills	22	16.73
345.10	Knitted and crochetted fabrics	35	30
346.35	Velvet, plush and velours	30	25
380.06	Men's and boys' knitted shirts	25	35
380.09	Men's and boys' coats	20	16.5
380.27	Men's and boys' dress shirts	25	21
380.39	Other men's and boys' apparel	20	17.5
382.00	Women's and girls' apparel	42.5	35
382.06	Sweaters	25	21

SOURCE: U.S. Trade Commission, Tariff Schedules of the United States -- Annotated (1975) (Washington, D.C.: United States International Trade Commission, 1975).

Corden,[1] Melvin and Wilkinson[2] and Grubel and Johnson,[3] have tended to support this claim. The particular level of a nominal tariff on the final product of an industry will permit local producers of the protected commodity to raise their domestic selling prices while remaining competitive with imports. However, the nominal rate will not necessarily reflect the actual extent of protection of the value added that is accorded to that industry by the tariff structure if tariffs on the importation of the final goods are greater than on the raw materials.

The effective rate of protection is defined as "the percentage increase in the value added per unit of output made possible by the tariff structure of a country relative to the situation before any tariffs were imposed."[4] Although both nominal and effective rates are measures of the extent of protection afforded a local industry, the two concepts are different in that the former is basically

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[1] W.M. Corden, The Theory of Protection (London: Clarendon Press, 1971).

[2] James R. Melvin and Bruce W. Wilkinson, Effective Protection in the Canadian Economy, Economic Council of Canada Special Study No. 9 (Ottawa: Queen's Printer, 1968).

[3] Herbert G. Grubel and Harry G. Johnson (eds.), Effective Tariff Protection (Geneva: GATT and Graduate Institute of International Studies, 1971).

[4] Harry G. Johnson, "Economic Development and International Trade" in R.E. Caves and H.G. Johnson (eds.), Readings in International Economics (London: Allen & Unwin, 1968), pp. 285-86.

used to collect import taxes at the port of entry in the importing country. The latter, however, applies more directly to the competitive situation between local and foreign industries since it is concerned with how the structure of nominal rates affects the production pattern of an industry by specifying the effects that nominal tariffs have on the value added in a given industry.

For example, suppose that cotton fabrics are subject to a 30 percent import duty while cotton yarn is imported free of duty. Suppose also that the cotton input accounts for 50 percent of the value of the finished fabric; that is, the value added by the cotton fabric industry is the remaining half of the value of the finished product. The effective rate of protection for the domestic fabric industry will be greater than indicated by the nominal tariff. In this case, the 30 percent tariff on the fabrics will in fact be a 60 percent tariff on the value added by the domestic fabric industry.[1] The difference between the nominal and effective rates depends on the proportion of the final value of the commodity contributed by the input component and on the relative levels of the nominal rates according to the stage of manufacturing.

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[1] For the assumptions of and the various methods used to calculate the effective rates of protection, see: J.R. Melvin and B.W. Wilkinson, Effective Protection in Canada; W.M. Corden, The Theory of Protection; and H.G. Grubel and H.G. Johnson (eds.), Effective Tariff Protection.

The difference in these two concepts of tariff protection for various fibre products in Canada can be seen in Table 2.12. In general, the effective rates of protection for fibre products in Canada in 1963 were considerably higher than the nominal rates. In several instances, the effective rate of protection was double or more the nominal rate. This feature results from the tendency for tariffs on final products to be higher than those on the inputs.[1] The high levels of the effective rates of protection tend to support the contention of developing countries that tariff barriers should be substantially reduced, if not removed.

However, in many cases, imports are restricted not only by tariffs but also by a score of non-tariff barriers such as quotas, import licenses, hygiene levels and transport arrangements.

Major Fibre End-Uses

The major reason for the long-run declining trend in the use of cotton has been the competition from synthetic fibres in the end-use markets. This section attempts to show where this competition has been most effective in the

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[1] If nominal tariff rates on the input are less than, equal to, or greater than those on the final products, the effective rates of protection will be greater than, equal to, or less than the nominal rates, respectively.

TABLE 2.12

NOMINAL AND EFFECTIVE TARIFF RATES

FOR CANADA, 1963

Industry	Nominal Tariffs	Effective Tariffs
	(Percentages)	
Cotton yarn and cloth	20.0	40.0
Narrow fabric mills	19.4	26.6
Synthetic textiles	30.3	64.0
Wool yarns	10.8	29.2
Wool cloth	19.3	42.6
Embroidery, pleating, etc.	20.2	24.0
Auto fabrics	30.3	90.9
Miscellaneous textiles	15.4	19.4
Knitting mills	31.1	77.1
Hosiery mills	25.2	40.1
Carpet, mat and rug	28.2	66.8

SOURCE: James R. Melvin and Bruce W. Wilkinson, Effective Protection in the Canadian Economy, Economic Council of Canada Special Study No. 9 (Ottawa: Queen's Printer, 1968).

major consumption area of the United States.[1]

The major fibre end-uses can be summarized into four categories: men's and women's apparel, household furnishings, industrial uses, and other consumer products. Over the 15 year period from 1960 to 1974, cotton has been increasingly used less in all end-uses. The largest losses have been in industrial uses and household furnishings. In the apparel section, women's clothing showed the largest loss, while men's clothing had the smallest.

Men's and Women's Apparel

For a long time this was the main use for cotton. Since the 1950's, however, cotton has suffered severe losses to synthetic fibres, especially during the 1960's (see Table 2.13). Cotton's use has fallen from an annual average of 1,858 million pounds (61.3 percent) over the period from 1960 to 1964, to 1,515 million pounds (36 percent) of total fibre consumption in apparel in 1974. Synthetic fibre use, on the other hand, has risen from an annual average of 820 million pounds over the period from 1960 to 1964, to 2,628 million pounds in 1974, an increase of 1,808 million pounds over the 15 year period. The largest increase has been in non-cellulosic fibres whose

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[1] The available end-use data apply to the United States. However, except for developing countries and the Soviet Union, where cotton is still the major textile fibre, these data give a general picture of the trends in fibre end-use that apply in most countries.

use in apparel increased by 42 to 53 percent over the same period. However, if the current demand for certain types of textiles such as denim and corduroy continues, cotton may recoup some of its losses. In 1974, denim fabrics accounted for over 10 percent of the consumption of cotton in the United States.[1]

Household Furnishings

This category includes items such as bedsheets, blankets, towels; carpets, mats and rugs; furnishings and upholstery materials. The major use of cotton here is in sheets where cotton accounts for about 80 percent of the fibres used.[2] However, even this use has been greatly penetrated by non-cellulosic fibres, especially by cotton-polyester blends. A household furnishing use where cotton is still very important is in towels where cotton accounts for about 98 percent of the fibres used.

The major losses in cotton use in this category have been in carpets and rugs. The main reason for this loss is that cotton is not well suited for this use while synthetic fibres, particularly non-cellulosics, have been produced with the right qualities for carpets and rugs.

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[1] Commonwealth Secretariat, Wool Intelligence, Vol. 28, No. 8 (August, 1975), p. 564.

[2] George E. Dudley, U.S. Textile Fiber Demand: Price Elasticities in Major End-Use Markets, U.S.D.A., Economic Research Service, Technical Bulletin No. 1500 (Washington, D.C.: September, 1974), p. 46.

TABLE 2.13

UNITED STATES MAJOR FIBRE END-USES, 1960-1974

End-Use	Year	Cotton	Wool	Cellulosics	Non-Cellulosics*	Total	Cotton	Wool	Cellulosics	Non-Cellulosics
		Million Pounds					Percentages			
Apparel	Average 1960-1964	1858	358	366	454	3036	61.3	11.8	12.0	14.8
	1965	1870	371	438	739	3418	54.7	10.9	12.8	21.6
	1966	1887	367	454	849	3557	53.1	10.3	12.8	23.9
	1967	1704	355	542	1022	3623	47.0	9.8	15.0	28.2
	1968	1802	315	657	1263	4037	44.6	7.8	16.3	31.3
	1969	1669	280	659	1285	3893	42.9	7.2	16.9	33.0
	1970	1630	206	575	1448	3859	42.2	5.3	14.9	37.5
	1971	1661	131	572	1780	4144	40.1	3.2	13.8	43.0
	1972	1646	133	539	2120	4438	37.1	3.0	12.1	47.8
	1973	1608	122	548	2547	4825	33.3	2.5	11.4	52.8
	1974	1515	88	387	2241	4231	35.8	2.1	9.1	53.0
Home Furnishings	Average 1960-1964	1103	157	371	288	1920	57.9	8.7	19.0	14.6
	1965	1243	122	507	581	2453	50.7	5.0	20.7	23.7
	1966	1275	120	505	661	2561	49.8	4.7	19.7	25.8
	1967	1229	99	471	781	2580	47.6	3.8	18.3	30.3
	1968	1291	110	481	869	2752	45.4	3.4	16.0	35.2
	1969	1319	108	438	1248	3113	42.4	3.5	14.1	40.1
	1970	1285	88	365	1311	3049	42.1	2.9	12.0	43.0
	1971	1259	83	385	1643	3370	37.4	2.5	11.4	48.8
	1972	1278	86	338	2063	3770	33.9	2.3	9.0	54.7
	1973	1171	46	331	2431	3979	29.4	1.2	8.3	61.1
	1974	969	28	264	2153	3414	28.4	0.8	7.7	63.1

* Non-cellulosic figures include textile fibre glass.

TABLE 2.13 (CONTINUED)

End Use	Year	Cotton	Wool	Cellulosics	Non-Cellulosics	Total	Cotton	Wool	Cellulosics	Non-Cellulosics
		Million Pounds					Percentages			
Industrial Uses	Average 1960-1964	593	10	274	371	1250	47.5	0.8	22.0	29.6
	1965	599	8	279	553	1439	41.6	0.6	19.4	38.4
	1966	649	9	265	673	1598	40.6	0.6	16.6	42.1
	1967	647	8	228	713	1597	40.5	0.6	14.3	44.6
	1968	583	8	256	958	1805	32.3	0.4	14.2	53.1
	1969	546	9	222	1071	1848	29.5	0.5	12.0	58.0
	1970	501	8	191	936	1636	30.6	0.5	11.7	57.2
	1971	481	8	265	1068	1822	26.4	0.4	14.5	58.6
	1972	469	8	275	1296	2048	22.9	0.4	13.4	63.3
	1973	465	9	238	1485	2197	21.2	0.4	10.8	65.6
	1974	381	9	182	1483	2055	18.5	0.4	8.9	72.2
Other Consumer Products	Average 1960-1964	417	30	220	84	752	55.7	4.0	29.2	11.0
	1965	445	34	305	133	917	48.5	3.7	33.3	14.5
	1966	473	33	334	159	999	47.3	3.3	33.4	15.9
	1967	464	33	337	164	998	46.5	3.3	33.8	16.4
	1968	391	33	255	188	867	45.1	3.8	29.4	21.7
	1969	385	31	266	236	918	41.9	3.4	29.0	25.7
	1970	372	34	259	340	1005	37.0	3.4	25.8	33.8
	1971	398	31	237	486	1152	34.5	2.7	20.6	42.2
	1972	391	27	233	581	1232	31.7	2.2	18.9	47.2
	1973	379	16	232	681	1308	29.0	1.2	17.7	52.1
	1974	377	8	236	674	1295	29.1	0.6	18.2	52.1

SOURCE: Textile Economics Bureau, Textile Organon (New York: Textile Economics Bureau, Various Issues).

In general, cotton use in household furnishings has fallen from an annual average of 58 percent over the period from 1960 to 1964, to 28 percent of the fibres used in 1974. Synthetic fibre use rose from 33.6 to 70.8 percent over the same period (see Table 2.13).

Industrial Uses

This category accounts for about 13 percent of cotton end-use. It includes sewing threads, cordage and twine, coated fabrics and tire cord. Cotton's share in this market has dropped from an annual average of 47.5 percent over the period from 1960 to 1964, to 18.5 percent in 1974. The largest losses have been in cordage, especially tire cord. Non-cellulosic fibres had the largest gains in use in this category. Their use rose from an annual average of 30 percent over the period from 1960 to 1964, to 72 percent of the total fibres used in 1974 (see Table 2.13).

Other Consumer Products

This is the smallest market for cotton. It covers apparel lining, retail piece goods, medical supplies, and shoes and slippers. Cotton's share in this use fell from an annual average of 55.7 percent over the period from 1960 to 1964, to 29 percent of the total fibres used in 1974. Synthetic fibre use increased by 30 percent to 70 percent over the period from 1960 to 1974 (see Table 2.13).

The gain was exclusively accounted for by non-cellulosic fibres.

Summary

Although the use of synthetic fibres has benefited from the losses in use incurred by cotton and wool, cellulosic fibres, too, have been declining in many end-uses, the main ones being industrial uses and other consumer products. The gain by non-cellulosic fibres has been attributed to their being suited for most of the end-uses and to the fact that their prices have decreased significantly over the past two decades (see Table 3.4). Wool use declined in all end-uses over the period from 1960 to 1974.

This study focuses on the competition against cotton from the other major fibres, particularly the non-cellulosic fibres. The next chapter discusses some of the factors that influence the demand for fibres, and outlines the economic model that was used to analyse the influence of these factors.

CHAPTER III

THE DEMAND FOR COTTON

Introduction

Demand relationships for fibres occur at three distinct levels. These are: the consumers' demand for final textile goods at the retail level; the manufacturers' demand for fabrics at the point of final goods production; and the processors' demand for raw fibres at the mill level. The demand by manufacturers and processors can be viewed as being derived from the consumers' response at the retail level. The feature that it is a derived demand relationship has implications for demand characteristics such as own-price elasticity of demand for the raw fibre.

Effect of Substitutes

A number of factors appear to be relevant in affecting the level and characteristics of demand for cotton fibre. They include the relative ease of substitution by other fibres. The more easily other fibres can substitute for a given commodity such as cotton, the more price elastic that commodity can be expected to be. The exist-

ence of substitutes for cotton and their relative ease of substitution in turn appears to be related to technology and to the existing and likely future market price relationships. The characteristics of demand for the final product produced from a raw material such as cotton are expected to affect the demand for that raw material. It can also be generally expected that the more price elastic the demand for the final product is, the more price elastic the demand for the raw material input will be.[1] In addition, the price elasticity of demand for a raw material input such as cotton may be greater in the long-run than in the short-run due to the fact that it takes time for users to adjust to price and technological changes.

Of all these factors, substitution seems to be of particular interest to the textile industry. The level of own-price elasticity of demand for natural fibres such as cotton is also of interest. The demand for cotton has been found to be price inelastic in the short-run but elastic in the long-run[2] which raises the question as to whether price can still be considered the major short-run

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[1] Edwin Mansfield, Microeconomics: Theory and Applications (New York: W.W. Norton and Company, Inc., 1970), p. 343.

[2] Frederick V. Waugh, Demand and Price Analysis: Some Examples from Agriculture, Economic Research Service, Technical Bulletin No. 1316 (Washington, D.C.: U.S.D.A., 1964).

factor in inter-fibre competition.

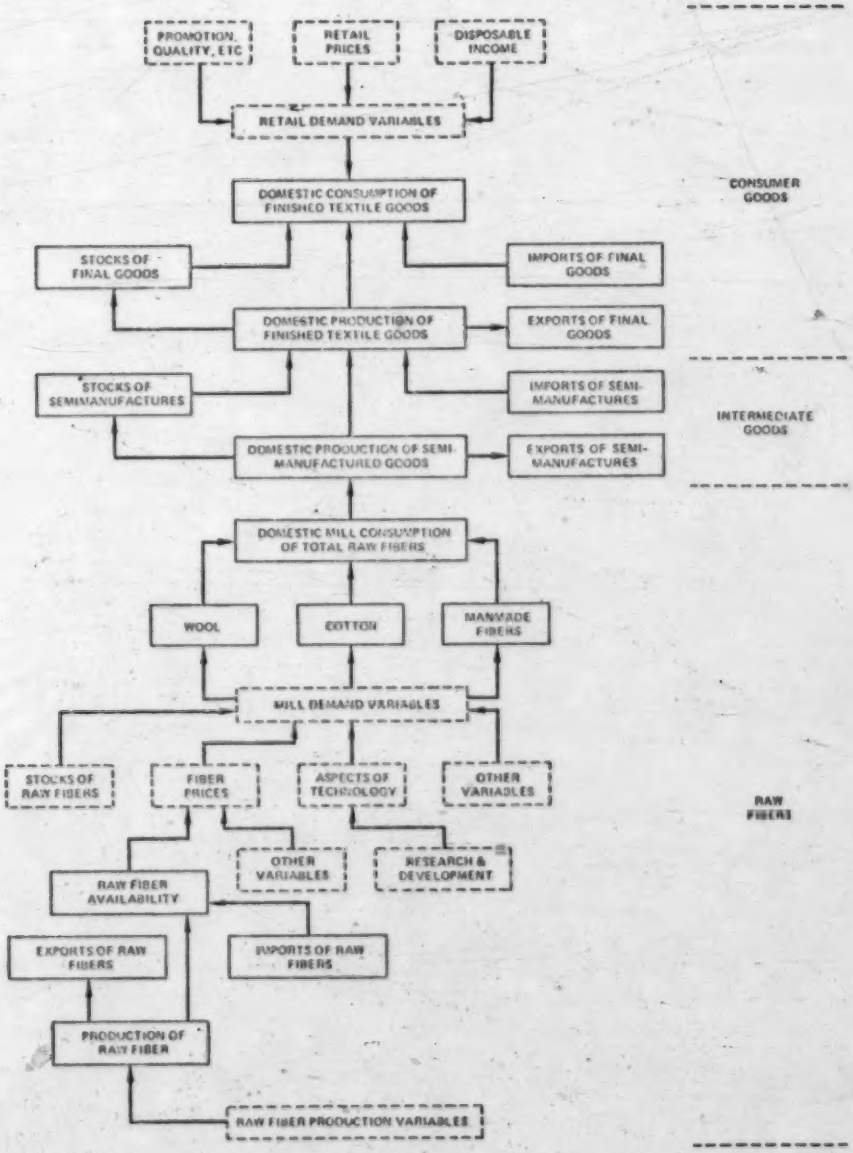
Not only is the demand function for cotton apparently unresponsive to price changes in the short-run, but the supply function for cotton also appears to be price inelastic. Further, there is supply variability due to the effects of weather and pests. The resultant price instability for the natural fibre is in contrast with the more or less controlled supply of synthetic fibres and their tendency toward fairly stable and declining prices. These factors have tended to result in a decline in the total fibre market share for cotton. In the United States, the government has used a variety of programmes intended to enhance and stabilize the price of cotton and the income position of cotton producers. These programmes have included acreage allotment and diversion, price supports, export programmes, and import controls. Other programmes affecting this commodity are the 1966 Cotton Research and Promotion Act and the 1970 Agricultural Act which provide funds for cotton research and promotion in an effort to increase the competitive situation of cotton.

Market Flows from Producer to Consumer

Important relationships in the processing and marketing of fibre products are presented in Figure 1. This figure assumes that weaving and knitting mills account for the processing of all intermediate goods. It summa-

FIGURE 1

MARKET FLOW OF TEXTILE FIBRES FROM PRODUCER TO CONSUMER



SOURCE: Lionel F. Ward and Gordon A. King, Inter-fiber Competition with Emphasis on Cotton, Trends and Projections to 1980, Economic Research Service, Technical Bulletin No. 1487 (Washington, D.C.: U.S.D.A., 1973), p. 4.

rizes the processing and marketing procedures for the raw product, semi-manufactured goods, and the final textile products. It also illustrates interdependencies between these relationships and identifies the principal variables that influence the demand by processors and consumers.

Previous Studies

This section presents a brief review of selected recent studies[1] relating to the United States' demand for cotton.

From their study of textile fibre demand in the United States, Donald et al.[2] concluded that income was the major factor influencing total individual fibre demand, while own-price played a rather minor role as seen from their estimate of a price elasticity of demand of -0.3. Ward and King's[3] later study showed similar results. In

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[1] There are a number of other studies of the demand for textile fibres in the United States. Those summarized here focus on the relationship between cotton and other fibres.

[2] James R. Donald, Frank Lowenstein, and Martin S. Simon, The Demand for Textile Fibres in the United States, Economic Research Service, Technical Bulletin No. 1301 (Washington, D.C.: U.S.D.A., 1963).

[3] Lionel F. Ward and Gordon A. King, Interfiber Competition with Emphasis on Cotton: Trends and Projections to 1980, Economic Research Service, Technical Bulletin No. 1487 (Washington, D.C.: U.S.D.A., December, 1973).

these studies, other important factors explaining the variability in demand for fibres were the level of stocks and time. In the study by Donald et al., the stock variable was particularly important in the estimated demand function for wool; it's inclusion increased the explained variation in consumption from 53 percent[1] to 83 percent.

Waugh,[2] writing at about the same time as Donald et al., was concerned with the apparent low price elasticity of demand for cotton. He concluded that although cotton consumption responded to changes in income, it was relatively unresponsive to price changes in any one year. He estimated the short-run price elasticity of cotton as -0.29 and that for the long-run as -1.84. This suggested to Waugh that time could be an important explanatory variable for individual textile fibres, especially in the case of synthetics whose availability, price, and, therefore, consumption, depend largely on technological improvements in quality which arise from research and promotion efforts. He argued that the short-run unresponsiveness to price of the demand for cotton in the United States could be attributed to the influence of government price support programmes. These programmes may have distorted current

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[1] For an explanation of the low explained variation in the consumption of wool, see Donald et al., The Demand for Textile Fibers, pp. 75-76.

[2] F.V. Waugh, Demand and Price Analysis.

supply and market conditions, and thus have resulted in failure for cotton to adjust to market conditions.

Lewis,[1] using data covering the period from 1920 to 1970, also concluded that the demand for individual fibres was own-price inelastic, with cotton having the lowest price elasticity. This, he argued, could be due to the fact that fibres are raw materials in the production of final textile products. Their costs may, therefore, represent only a small portion of the total cost of the final product. In addition, many of the final textile products can be regarded as necessities rather than luxuries. His analysis encountered problems of multi-collinearity and he suggested that the income variable had "picked up" some of the own-price effects, especially in the case of synthetic fibres. Lewis also concluded that cotton was a normal good whose demand was income inelastic.

In the long-run, Lewis found cotton to be considerably more responsive to non-cellulosic price changes than to changes in its own-price. Both Lewis and Ward found synthetic fibre prices to be important in mill fibre demand for cotton, but they pointed out that besides prices there are other important non-price variables whose effect may have been observed by income and price.

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[1] Kenneth A. Lewis, "An Econometric Analysis of the Market for Textile Fibers," American Journal of Agricultural Economics, Vol. 54, No. 2 (May, 1972), pp. 238-244.

Smith and Dardis[1] examined twenty end-uses over the period from 1950 to 1967. They found that although the quantity of cotton demanded increased over the period, its market share had declined in thirteen end-uses. In the case of women's apparel, retail piece goods, carpets and rugs, automobile use, and men's hosiery, both the quantity of cotton demanded and its market share declined over the period. The authors found that the consumer shift from cotton to other fibre products was greater than that from other fibres to cotton products. Their analysis projected both a gradual decline in cotton consumption and eventual elimination from at least eleven end-use markets. However, in some end-uses, for example, sheets and other bedding, the eventual replacement of cotton by non-cellulosics may have been an overestimate. Smith and Dardis suspected that they may have overestimated the extent of replacement of cotton by polyester, a fibre that is generally used in blends rather than in its pure form. The authors, therefore, suggested that policy, especially in the fields of supply and price stabilization and research and promotion, should be improved to counteract the observed trends.

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[1] B. Smith and R. Dardis, "Inter-Fiber Competition and the Future of the United States Cotton Industry," American Journal of Agricultural Economics, Vol. 54, No. 2 (May, 1972), pp. 209-216.

Ward and King[1] used a three sector model at both static and dynamic levels. They found that income, own-price and population were the major explanatory variables in the static model, while stocks and income were important explanatory variables in the dynamic model, especially for synthetic fibres. Fibre market share for the major end-uses was estimated by use of the Gompertz curve. The analysis showed that cotton's market share in men's and women's apparel, household furnishings, and tire uses had been declining since 1960, a result similar to that found by Smith and Dardis. Their mill fibre consumption projections for 1980 were expected to be 93.73[2] cotton equivalent pounds per caput. This would represent an increase of 30.26 cotton equivalent pounds over the 1968 observed figure of 63.47 pounds per caput. Their estimates of per caput mill consumption suggested that the market share for cotton would fall to 23 percent, wool to 1 percent, and cellulosics to 12 percent, while non-cellulosics would increase to 64 percent of the total United States fibre market by 1980.

The Model

Demand theory indicates that the amount of a commo-

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[1] L.E. Ward and G.A. King, Interfiber Competition with Emphasis on Cotton.

[2] This was based on the estimated income elasticities.

dity purchased is a function of the size of the population, the level of real disposable income, the commodity's own-price, and the prices of substitutes and complementary goods, as well as other variables, such as tastes, fashion, and acceptability. These "other variables" are generally unquantifiable but have some influence on the amounts purchased and consumed and cannot, therefore, be ignored. The variables mentioned here are of particular importance in the competitive situation between the four major fibres -- cotton, wool, cellulosic and non-cellulosic fibres. In addition, the technical attributes of each of these fibres may affect its demand and influence the extent of substitution.

The model presented in this section is designed to examine the effect that a number of explanatory variables, namely income, population, price and, in some cases, some of the unquantifiable variables represented by a time variable, have on the quantity of cotton which is consumed. Single equation demand models where the quantity consumed is the dependent variable were postulated rather than a system of simultaneous equations. This formulation assumes that the cotton price is predetermined. This assumption is made in view of the features that the supply of cotton is controlled through acreage allotment and diversion programmes and that price levels are also controlled by price support operations. The models are tested in both linear and logarithmic formulations.

The quantity of cotton demanded per head in a given year can be viewed as a function of its own-price and the per caput real disposable income in that year. In equation form:

$$Q = \beta_0 + \beta_1 P_1 + \beta_5 Y + \mu \qquad (3.1)$$

where Q = the per caput mill consumption of cotton in a given year, in pounds;

P_1 = the retail price index of cotton, average 1957-1959 = 100;

Y = the real per caput disposable income, in 1958 dollars, and

μ = the random error term.

Cotton has been facing much competition from synthetic fibres, and to a lesser extent, from wool. The following four equations are designed to measure the effect of this competition.

$$Q = \beta_0 + \beta_1 P_1 + \beta_3 P_3 + \beta_5 Y + \mu \qquad (3.2)$$

$$Q = \beta_0 + \beta_1 P_1 + \beta_4 P_4 + \beta_5 Y + \mu \qquad (3.3)$$

$$Q = \beta_0 + \beta_1 P_1 + \beta_3 P_3 + \beta_4 P_4 + \beta_5 Y + \mu \qquad (3.4)$$

$$Q = \beta_0 + \beta_1 P_1 + \beta_2 P_2 + \beta_3 P_3 + \beta_4 P_4 + \beta_5 Y + \mu \qquad (3.5)$$

where P_2, P_3 and P_4 are the retail price indices for wool, cellulosic and non-cellulosic fibres, respectively, average 1957-1959 = 100.

The studies of Donald et al.[1] and of Ward and King[2] suggested that stocks and time were also important explanatory variables. However, no reliable data series on stocks were available for this study and so this variable could not be included. The variable of time was used as a proxy for such unquantifiable variables as changes in tastes over time. The following five equations are essentially the same as equations 3.1 to 3.5 except for the addition of time as an explanatory variable.

$$Q = \beta_0 + \beta_1 P_1 + \beta_5 Y + \beta_6 T + \mu \qquad (3.6)$$

$$Q = \beta_0 + \beta_1 P_1 + \beta_3 P_3 + \beta_5 Y + \beta_6 T + \mu \qquad (3.7)$$

$$Q = \beta_0 + \beta_1 P_1 + \beta_4 P_4 + \beta_5 Y + \beta_6 T + \mu \qquad (3.8)$$

$$Q = \beta_0 + \beta_1 P_1 + \beta_3 P_3 + \beta_4 P_4 + \beta_5 Y + \beta_6 T + \mu \qquad (3.9)$$

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[1] Donald et al., The Demand for Textile Fibres, 1963.

[2] Ward and King, Interfiber Competition with Emphasis on Cotton.

$$Q = \beta_0 + \beta_1 P_1 + \beta_2 P_2 + \beta_3 P_3 + \beta_4 P_4 + \beta_5 Y + \beta_6 T + \mu \quad (3.10)$$

where T is the time variable, T = 1,2,...,23, 1947 = 1, and all other variables are as defined above.

All the above equations postulate a linear relationship between fibre consumption and the explanatory variables. Since it is possible that a multiplicative relationship may apply, the above equations were also tested in double-logarithmic formulations.[1]

It has been noted that since the mid-fifties, cotton has faced increased competition from non-cellulosic fibres which have made strong gains in the market. This change may not have been reflected in the previous regressions which were fitted to data covering the whole study period (1947 to 1969). This feature led to the retesting of estimating equations 3.1 to 3.5 on data covering the last fourteen years of the study period. This allowed a more accurate check on the influence of non-cellulosic fibres on cotton consumption over the period from 1956 to 1969. These equations were also tested in double-logarithmic formulation.

On the assumption that current consumption is a function of prices and income in the previous year, equations 3.1 to 3.5 were retested with a one year lag applying to

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[1] This provides for the possibility that as consumption increases, it may approach a saturation level.

the explanatory variables of prices and income. Again, these equations were fitted to both the linear and double-logarithmic formulations.

Because of the existence of positive auto-correlation in equation 3.1 and inconclusive Durbin-Watson tests for many of the other estimating equations, equations 3.1, 3.3, 3.4 and 3.5 were rerun using "first differences" of the observations in an effort to remove the problem of positive auto-correlation and obtain more conclusive results.

Estimating equation 3.5 was also fitted to quarterly data. However, changes within the year in price and income generally have some influence on the amount purchased and consumed of a given commodity and this would not be reflected in equation 3.5. The following model was designed to measure these effects.

$$Q = \beta_0 + \beta_1 P_1 + \beta_2 P_2 + \beta_3 P_3 + \beta_4 P_4 + \beta_5 Y$$

$$+ \gamma_1 + \gamma_2 + \gamma_3 + \mu \qquad (3.11)$$

where γ_1, γ_2 and γ_3 are quarterly dummy variables indicating the first, the second and the third quarters of the year respectively; and all other variables are defined as before.

Equations 3.5 and 3.11 were finally fitted to quarterly data for the period from 1963 to 1967 to form the basis

for estimating short-run elasticities of demand.

The above linear equations were estimated using least squares regression methods. The models were fitted to annual and quarterly time series data for the United States. The time series involved were from 1947 to 1969 for annual data and from 1954 to 1967 for quarterly data. The choice of the latter period was largely based on data availability.

The results are presented in the following chapter. The remaining section of this chapter outlines the data used in this study.

The Data

This section outlines the data and their respective sources. Some of the data were transformed before presentation and do not directly relate to the original sources; these instances are noted in this section.

Per Caput Mill Consumption

The per caput consumption of the various fibres for the United States was calculated by adjusting domestic mill consumption by the net trade balance fibre content of finished and semi-manufactured goods. The results were divided by the July 1st resident population figures[1] to

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[1] U.S. Bureau of the Census, Statistical Abstract of the United States, (90-93rd editions), (Washington, D.C.: U.S. Bureau of the Census, 1969-1972).

obtain the per caput values. An adjustment for stock changes was not possible since reliable data were not available.

All the consumption data are presented in terms of cotton equivalent pounds. This feature is due to the fact that some fibres substitute for more or less of a given fibre than do others. The amount of waste in fibre processing is different for each fibre and is thus taken into account. In addition, this provides a common measurement base which simplifies the analysis. The conversion factors are detailed in Table 3.1.

The resulting annual per caput consumption data are presented in Table 3.2. The basic data were obtained from Cotton Statistics and Related Data, 1920-73;[1] Cotton Situation;[2] Wool Statistics and Related Data;[3] and Textile Organon.[4] Quarterly data were developed for the period 1954 to 1967 from the same sources and are given in Table 3.3

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[1] U.S.D.A., Statistics on Cotton and Related Data, 1920-1973, Economic Research Service, Statistical Bulletin No. 535 (Washington, D.C.: U.S.D.A., 1974).

[2] U.S.D.A., Cotton Situation (Washington, D.C.: U.S.D.A., Various Issues).

[3] U.S.D.A., Wool Statistics and Related Data, 1920-64, and 1967 Supplement, Economic Research Service, Statistical Bulletin No. 363 (Washington, D.C.: U.S.D.A., July, 1965 and May, 1968).

[4] Textile Economics Bureau, Textile Organon, Various Issues.

TABLE 3.1

FIBRE CONVERSION FACTORS

Fibre		Conversion Rate
Cotton		1.00
Wool		0.55
Rayon and Acetate:	Yarn	1.51
	Fibre	1.10
Non-Cellulosics:	Yarn-Industrial	2.73
	-Other	1.74
	Fibre	1.37

SOURCE: George E. Dudley, U.S. Textile Fiber Demand: Price Elasticities in Major End-Use Markets, Economic Research Service, Technical Bulletin No. 1500 (Washington, D.C.: U.S.D.A., September, 1974), p. 61, n. 1. See also J.R. Donald, F. Lowenstein and M.S. Simon, The Demand for Textile Fibers in the United States, Economic Research Service, Technical Bulletin No. 1301 (Washington, D.C.: U.S.D.A., 1963).

TABLE 3.2

U.S. PER CAPUT FIBRE CONSUMPTION, 1947-1969

(IN COTTON-EQUIVALENT POUNDS)

Year	Cotton	Wool	Cellulosics	Non-Cellulosics	Total
1947	32.4	2.7	9.7	0.6	45.4
1948	30.4	2.6	11.1	0.8	45.0
1949	25.7	1.8	9.6	1.1	38.0
1950	30.9	2.3	12.5	1.6	47.3
1951	31.6	1.7	11.5	2.2	47.0
1952	28.5	1.6	10.9	2.7	43.7
1953	27.9	1.7	10.9	3.0	43.5
1954	25.4	1.3	9.9	3.5	40.2
1955	26.5	1.4	12.1	4.6	44.6
1956	25.9	1.4	10.1	5.1	42.6
1957	23.7	1.2	9.7	5.9	40.5
1958	22.2	1.0	9.1	5.9	38.3
1959	24.5	1.3	10.0	7.5	43.3
1960	23.2	1.3	8.2	7.7	40.4
1961	22.2	1.2	8.5	8.5	40.4
1962	22.4	1.3	9.3	10.4	43.3
1963	21.3	1.2	10.2	11.8	44.5
1964	22.1	1.0	10.7	14.3	48.1
1965	23.0	1.1	10.8	17.4	52.3
1966	23.5	1.0	10.8	20.3	55.7
1967	22.2	0.9	10.0	22.5	55.6
1968	20.6	0.9	11.1	29.2	61.8
1969	19.4	0.9	10.5	31.8	62.4

SOURCE: Derived from U.S.D.A., Statistics on Cotton and Related Data, 1920-73, Economic Research Service, Statistical Bulletin No. 535 (Washington, D.C.: U.S.D.A., 1974), and U.S.D.A., E.R.S., Cotton Situation (Washington, D.C.: U.S.D.A., Various Issues).

Fibre Prices

There are many grades of each major fibre and each grade has its own price. In order to reduce these prices to a manageable series, representative grades were selected for each group. Cotton was represented by the average annual price of American middling 15/16 inch staple cotton. Wool was represented by the average of clean, fine combing and staple wool at the Boston Market. Prices for man-made fibres are weighted values compiled from the list of prices published in the Modern Textile Magazine.[1] These price lists do not give the actual trading prices due to the fact that companies give discounts and there is no way of accurately assessing the actual prices. The published price lists are the only available indication of the actual price.

All prices were converted to indices based on the average of 1957 to 1959 defined equal to 100. These are presented in Table 3.4. The indices are deflated by the consumer price index for total consumer expenditures.[2] The non-cellulosic fibres index for the years before 1953 was based on the nylon price. This was stable during the

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[1] Rayon Publishing Corporation, Modern Textile Magazine (New York: Rayon Publishing Corporation, Various Issues). (Formerly Rayon and Synthetic Textile Magazine).

[2] U.S. Department of Labour, Consumer Price Indexes for Selected Items and Groups (Washington, D.C., Bureau of Labour Statistics, 1970).

TABLE 3.3

QUARTERLY PER CAPUT FIBRE CONSUMPTION, RETAIL FIBRE PRICE INDICES, AND PER CAPUT DISPOSABLE INCOME

Quarter		Fibre Consumption				Price Indices				
		Cotton	Wool	Cellulosics	Non-Cellulosics	Cotton	Wool	Cellulosics	Non-Cellulosics	Income
		(In Pounds)				(1957-1959 = 100)				(1958 Dollars)
1954	1	6.5	0.3	2.2	0.7	103.15	113.95	105.00	128.54	1566
	2	6.1	0.3	2.5	0.8	104.43	121.10	104.52	119.44	1562
	3	6.0	0.3	2.5	0.8	104.61	123.64	104.52	119.44	1578
	4	6.5	0.3	2.9	1.1	104.07	111.33	104.52	119.44	1610
1955	1	6.7	0.4	3.2	1.0	104.07	98.60	104.52	118.89	1604
	2	6.5	0.3	3.2	1.1	104.19	104.18	107.64	118.89	1643
	3	6.2	0.3	3.0	1.2	103.59	100.08	102.34	118.89	1681
	4	6.7	0.4	3.0	1.2	103.03	92.28	102.34	117.86	1706
1956	1	6.9	0.4	3.0	1.1	106.96	94.17	99.84	98.80	1696
	2	6.4	0.4	2.3	1.2	108.33	93.68	99.84	98.80	1721
	3	5.9	0.3	2.3	1.3	100.56	96.88	99.84	98.80	1744
	4	6.3	0.3	2.7	1.3	98.74	106.89	99.84	98.80	1781
1957	1	6.2	0.4	2.7	1.4	100.20	111.33	94.85	96.42	1766
	2	5.9	0.3	2.4	1.4	100.80	117.07	94.85	96.42	1787
	3	5.5	0.3	2.5	1.5	100.05	116.83	95.31	96.50	1812
	4	5.7	0.2	2.5	1.3	101.96	103.04	99.06	103.86	1812
1958	1	5.7	0.2	2.3	1.2	103.15	92.20	99.20	101.01	1785
	2	5.3	0.2	2.1	1.3	103.30	83.00	101.56	101.01	1798
	3	5.2	0.3	2.4	1.4	103.56	79.90	101.09	101.01	1840
	4	6.1	0.3	2.6	1.7	103.11	74.14	100.46	101.01	1868
1959	1	6.1	0.3	2.6	1.8	102.14	74.71	100.46	100.69	1862
	2	6.1	0.4	2.8	1.8	102.88	85.38	102.81	100.69	1900
	3	6.0	0.3	2.6	1.8	96.48	93.02	105.31	100.69	1900
	4	6.1	0.3	2.4	1.7	94.09	88.01	105.63	100.69	1924
1960	1	6.2	0.3	2.4	1.9	95.20	86.78	105.63	101.01	1918
	2	6.0	0.3	2.2	2.0	95.74	85.55	93.29	101.01	1939
	3	5.4	0.3	2.0	1.7	92.49	82.57	91.56	101.01	1949
	4	5.4	0.3	2.1	1.7	89.85	79.72	91.56	101.01	1946

TABLE 3.3 (CONTINUED)

Quarter		Fibre Consumption				Price Indices				Income
		Cotton	Wool	Cellulosics	Non-Cellulosics	Cotton	Wool	Cellulosics	Non-Cellulosics	
		(In Pounds)				(1957-1959 = 100)				(1958 Dollars)
1961	1	5.4	0.3	2.0	1.8	90.87	80.95	91.25	100.93	1932
	2	5.6	0.3	2.1	2.1	94.67	86.04	91.73	98.32	1963
	3	5.4	0.3	2.2	2.0	98.36	86.78	90.79	97.77	1997
	4	5.9	0.3	2.6	2.1	99.73	85.30	90.48	97.69	2040
1962	1	6.0	0.3	2.5	2.4	100.20	85.14	91.56	96.82	2031
	2	5.9	0.3	2.4	2.6	100.30	86.21	92.04	95.71	2059
	3	5.3	0.3	2.4	2.4	99.55	85.30	91.73	95.71	2074
	4	5.3	0.3	2.7	2.5	98.33	85.22	90.78	95.71	2095
1963	1	5.4	0.3	2.6	2.6	100.41	90.64	90.48	94.29	2096
	2	5.5	0.3	2.8	2.9	101.33	90.47	91.73	94.13	2117
	3	5.0	0.3	2.7	2.9	98.89	93.10	91.73	94.29	2150
	4	5.3	0.3	3.0	3.0	95.84	97.73	92.98	94.21	2188
1964	1	5.4	0.3	3.0	3.2	99.10	104.43	97.81	92.23	2206
	2	5.5	0.3	2.8	3.4	79.91	102.05	98.90	87.17	2267
	3	5.4	0.2	2.8	3.5	74.34	98.77	97.97	85.19	2299
	4	6.0	0.3	3.0	3.8	71.66	95.81	97.97	85.11	2323
1965	1	5.9	0.3	3.0	4.0	71.84	90.56	97.66	83.45	2346
	2	5.9	0.3	3.7	4.2	72.44	86.94	95.78	82.02	2392
	3	5.5	0.3	2.8	4.3	70.32	91.38	98.28	77.60	2474
	4	5.7	0.3	3.7	4.6	68.76	91.54	95.00	75.07	2530
1966	1	6.0	0.3	3.0	5.0	68.39	91.62	97.34	75.07	2542
	2	6.1	0.3	3.1	5.2	68.60	98.19	97.97	74.83	2574
	3	5.7	0.2	2.8	4.8	66.36	98.93	98.90	74.99	2625
	4	5.8	0.2	2.9	4.9	65.06	98.82	98.59	71.51	2674
1967	1	5.9	0.2	2.7	5.0	65.53	86.62	99.22	69.92	2684
	2	5.7	0.2	2.5	5.3	66.27	82.59	100.46	69.69	2724
	3	5.2	0.2	2.7	5.6	68.00	83.33	99.22	65.18	2771
	4	5.1	0.2	3.2	6.6	74.79	78.65	98.28	63.83	2818

SOURCE: Adopted from L.F. Ward and G.A. King, Interfiber Competition with Emphasis on Cotton: Trends and Projections to 1980, Economic Research Service, Technical Bulletin No. 1487 (Washington, D.C.: U.S.D.A., December, 1974). Appendix Table A-16, p. 93.

TABLE 3.4

U.S. RETAIL FIBRE PRICE INDICES AND DISPOSABLE INCOME, 1947-1969

Year	Cotton	Wool	Cellulosics	Non-Cellulosics	Income
			(1957-1959 = 100)		(1958 Dollars)
1947	107.89	84.26	120.82	132.60	1513
1948	100.31	105.82	121.90	132.41	1567
1949	99.31	107.33	120.91	132.00	1547
1950	132.85	144.57	123.97	131.84	1646
1951	122.99	197.31	131.86	132.39	1657
1952	108.95	116.01	126.18	133.71	1678
1953	104.68	123.77	109.57	133.55	1726
1954	105.70	122.76	105.07	119.32	1714
1955	107.26	107.69	106.95	116.96	1796
1956	100.93	105.11	100.46	97.30	1839
1957	102.74	120.14	96.44	99.76	1844
1958	102.83	86.62	99.84	100.21	1831
1959	94.44	93.58	103.79	100.10	1881

TABLE 3.4 (CONTINUED)

Year	Cotton	Wool	Cellulosics	Non-Cellulosics	Income
			(1957-1959 = 100)		(1958 Dollars)
1960	91.82	92.39	98.02	99.87	1883
1961	101.18	91.08	92.02	97.34	1909
1962	100.65	92.73	91.56	94.63	1968
1963	95.00	103.15	93.02	93.16	2013
1964	71.41	109.29	97.19	88.88	2123
1965	67.67	95.30	97.37	78.87	2235
1966	63.03	98.66	97.63	73.49	2332
1967	64.05	87.50	98.67	67.95	2401
1968	62.50	81.98	97.62	65.07	2474
1969	62.93	82.41	98.15	63.43	2507

SOURCE: Derived from U.S.D.A., E.R.S., Cotton Situation (Washington, D.C.: U.S.D.A., Various Issues); Textile Economics Bureau, Textile Organon (New York: Textile Economics Bureau, Various Issues); Rayon Publishing Corporation, Modern Textile Magazine (New York: Rayon Publishing Corporation, Various Issues); U.S.D.C., Office of Business Economics, The National Income and Product Account, 1929-65 (Washington, D.C.: G.P.O., August, 1966); and U.S.D.C., Office of Business Economics, Survey of Current Business, Income Supplement, 1970 (Washington, D.C.: G.P.O., 1970).

period from 1949 to 1952. Over this period acrylic and polyester fibres were still a negligible portion of the total market. The above price indices were calculated on an annual basis. Quarterly price indices were adopted from the study by Ward and King.[1]

Per Caput Disposable Income

Annual per caput disposable income data for the United States in 1958 dollars were obtained from the National Income and Product Account[2] and from the Survey of Current Business.[3] These are presented along with the price indices in Table 3.4.

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[1] L.F. Ward and G.A. King, Interfiber Competition with Emphasis on Cotton, Appendix Table A-16, p. 93.

[2] U.S.D.C., Office of Business Economics, The National Income and Product Account of the United States, 1929-65, Supplement to the Survey of Current Business (Washington, D.C.: G.P.O., August, 1966).

[3] U.S.D.C., Office of Business Economics, Survey of Current Business, National Income Issue, 1970 (Washington, D.C.: G.P.O., 1970).

CHAPTER IV

ANALYTICAL RESULTS

Introduction

In this study of the United States' demand for cotton, the unknown parameters, β_i, of the equations outlined in Chapter III were estimated through the use of the least squares method applied to the general linear model.[1] The results are presented in Tables 4.1 to 4.7. Tables 4.1 to 4.3 give the results of both the linear and double-logarithmic formulations of the models over the period from 1947 to 1969. Table 4.5 presents the results of the same models for the period from 1956 to 1969. Table 4.6 presents the results from the analysis of quarterly data for the period from 1954 to 1967 and from 1963 to 1967. Finally, Table 4.7 gives a summary of the estimated elasticities for the short-run and the long-run periods.

Tests of significance were based on the t-statistic, and the general usefulness of the various models was judged on the basis of the sign and significance of the coeffi-

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[1] For an exposition of the general linear model and its assumptions and properties, see J. Johnston, Econometric Methods (New York: McGraw-Hill Book Company, Inc., 1963), Chapter 5, pp. 121-175.

cients as well as on the explained variation in the per caput mill consumption of cotton as indicated by the R^2 values. The significance of the R^2 values was tested using the F-test.

The models used expressed per caput consumption of cotton as a function of the prices of cotton, wool, cellulosic and non-cellulosic fibres expressed as indices and the real per caput disposable income in each year. The price variables of each competing fibre were successively added to estimating equation 3.1 to gauge the effect of their inclusion in explaining the variation in the consumption of cotton. The model was fitted both without and with a time trend variable (see Tables 4.1 and 4.2, respectively); with the explanatory variables, price and income, lagged one year (see Table 4.3); and using a first-differences transformation of the variables (see Table 4.4).

Results of Models 3.1 to 3.5 Fitted to Annual Data, 1947-1969

The results from this step in the analysis are presented in Table 4.1. They indicate that the price index for cellulosic fibres was the major variable explaining changes in the consumption of cotton. This variable accounted for 78 percent of the 85 to 86 percent total explained variation in equations 3.2, 3.4 and 3.5. Income was the next most important explanatory variable for the

TABLE 4.1

RESULTS OF MODELS 3.1, 3.2, 3.3,[1] 3.4 AND 3.5, USING ANNUAL DATA, 1947-1969

Equation	Model Form	Estimated Coefficients[2]						R^2	Durbin-Watson Statistic
		β_0	β_1	β_2	β_3	β_4	β_5		
3.1	Linear	39.88	0.0184 (0.0558)	--	--	--	-0.0087** (0.0037)	62.72	0.932++
3.2	Linear	9.02	0.0174 (0.0357)	--	0.1958* (0.0358)	--	-0.0033 (0.0025)	85.53	1.799+
3.4	Linear	7.26	0.0165 (0.0370)	--	0.1886* (0.0548)	0.0124 (0.07)	-0.0026 (0.0047)	85.56	1.784
3.5	Linear	9.00	0.0104 (0.0449)	0.0053 (0.0209)	0.1843* (0.0588)	0.0093 (0.0729)	-0.0031 (0.0052)	85.61	1.781
3.1	Logarithmic	43290	-0.1055 (0.1771)	--	--	--	-0.9259* (0.2640)	69.10	1.324
3.2	Logarithmic	0.5386	0.0527 (0.1294)	--	0.7728* (0.1675)	--	-0.3060*** (0.2294)	85.43	1.767+
3.3	Logarithmic	0.7117	-0.1771 (0.1718)	--	--	0.5898** (0.3198)	-0.0891 (0.5178)	73.79	1.408
3.4	Logarithmic	0.0119	0.0279 (0.1411)	--	0.7315 (0.1900)	0.1346 (0.2705)	-0.1481 (0.3342)	85.63	1.756
3.5	Logarithmic	0.6956	-0.0147 (0.1602)	0.0643 (0.1070)	0.6793* (0.2121)	0.0553 (0.3054)	-0.3151 (0.4883)	85.93	1.782

[1] Equation 3.3 not included in the linear analysis.

[2] The standard errors are in parentheses.

* Significant at 99% level.

** Significant at 95% level.

*** Significant at 90% level.

\+ The hypothesis of no serial correlation is accepted.

++ The hypothesis of no serial correlation is rejected.

linear models while the price index for non-cellulosic fibres was the second most important in the logarithmic formulation. In seven cases the coefficient of the own-price variable was positive, but these estimates were not significantly different from zero. The income coefficients were negative. In the case of equation 3.1, this coefficient was significant at the 95 percent level. The positive sign for the own-price coefficients and the negative sign for the income coefficient are contrary to demand theory expectations. This feature is discussed further on page 75.

The coefficients for the cellulosic fibre price variable were significant at the 99 percent level except in the case of the logarithmic formulation of equation 3.4. These estimated coefficients are positive, suggesting that cellulosic fibres substitute for cotton.

Equation 3.1 in its linear formulation was the only equation showing evidence of positive auto-correlation. The other tests for auto-correlation were inconclusive except for equation 3.2.

Results of Models 3.6 to 3.10 Fitted to Annual Data, 1947-1969

In this set of equations, the time trend variable was included as a separate "catch all" variable in an attempt to capture the effect of some of the unquantifiable

non-price effects which may have affected the consumption of cotton. The results are presented in Table 4.2. The inclusion of the time variable in the linear model slightly improved the results obtained. All tests for auto-correlation were inconclusive and the explained variation, R^2, was slightly higher in all cases. The time variable became the major explanatory variable, followed by the price index of cellulosic fibres. These accounted for 79 and 7 percent, respectively, of the total explained variation in each case. The estimated coefficient of the time variable was significant at the 95 percent level or higher, while the coefficients for income and the cellulosic fibres price index were not highly significant. The own-price coefficient was still positive in this set of equations.

The double-logarithmic form of the models did not improve the results obtained from the linear models. The coefficient of the time variable, though still significant at the 95 percent level and over, lost its importance as an explanatory variable when two or more competing fibre price variables were included. In such cases, the competing fibre price indices became the major explanatory variables, led by the cellulosic price index.

Results of Models 3.2 to 3.5, Using
Lagged Price and Income Variables,
Annual Data, 1948-1969

In retesting models 3.2 to 3.5, these equations were

TABLE 4.2

RESULTS OF MODELS 3.6, 3.7, 3.8, 3.9 AND 3.10, USING ANNUAL DATA, 1947-1969[1]

Equation	Model Form	Estimated Coefficient							R^2	Durbin-Watson Statistic
		β_0	β_1	β_2	β_3	β_4	β_5	β_6		
3.6	Linear	6.51	0.0411 (0.0346)	--	--	--	0.0137* (0.0045)	-0.9708* (0.1670)	86.59	1.3 7
3.7	Linear	4.57	0.0317 (0.0336)	--	0.0958*** (0.0583)	--	0.0075 (0.0057)	-0.5880** (0.2825)	88.34	1.592
3.9	Linear	3.13	0.0309 (0.0349)	--	0.0901 (0.0703)	0.0101 (0.0647)	0.0081 (0.0068)	-0.5872** (0.2905)	88.36	1.589
3.10	Linear	7.77	0.0148 (0.0409)	0.0153 (0.0196)	0.0679 (0.0765)	0.0011 (0.0664)	0.0077 (0.0069)	-0.6444** (0.3028)	88.79	1.576+++
3.6	Logarithmic	0.1998	0.2402*** (0.1778)	--	--	--	0.2333 (0.4092)	-0.1471* (0.0442)	80.49	1.187
3.8	Logarithmic	0.0003	0.1819 (0.1518)	--	--	0.6846* (0.2367)	1.2877** (0.5007)	-0.1576* (0.0376)	86.75	1.415
3.9	Logarithmic	0.0983	0.1676 (0.1450)	--	0.3948*** (0.2356)	0.4059*** (0.2788)	0.7768*** (0.5664)	-0.1028** (0.0485)	88.63	1.489
3.10	Logarithmic	0.9305	0.1036 (0.1470)	0.1437*** (0.0983)	0.2024 (0.2633)	0.2986 (0.2813)	0.6108 (0.5599)	-0.1258** (0.0495)	89.97	1.5+++

[1] Equations 3.8 and 3.7 were omitted from the linear and logarithmic analyses, respectively.

* Significant at 99% level.

** Significant at 95% level.

*** Significant at 90% level.

+++ Test tables not available for k > 5.

reformulated to express current per caput mill consumption of cotton as a function of the previous year's price and income levels. The estimating equations were again fitted in both the linear and double logarithmic formulations. The results are presented in Table 4.3.

The results were not greatly improved in this retesting as compared to those in Table 4.1, except that the results from the lagged analysis were free from positive auto-correlation, save for equation 3.5 where the test was inconclusive. The price indices for cellulosic and non-cellulosic fibres were the major explanatory variables. Between them, these accounted for 81 percent of the total 83 percent explained variation in the consumption of cotton in equation 3.5. The estimated coefficients for the cellulosic price index were significant at the 95 percent level or higher, while the coefficients for the non-cellulosic fibre price index were not highly significant, except when used as the only competing fibre price variable. The coefficient on the own-price index was positive but was not significant.

Results of Models 3.1 to 3.5, Fitted to First Differences of the Variables, 1948-1968

In order to reduce the problem of positive auto-correlation which was apparent in equation 3.1 and to

TABLE 4.3

RESULTS OF MODELS 3.2, 3.3, 3.4 AND 3.5, USING LAGGED PRICE AND INCOME, 1948-1969

Equation	Model Form	Estimated Coefficients						R^2	Durbin-Watson Statistic
		β_0	β_1	β_2	β_3	β_4	β_5		
3.2	Linear	7.68	0.0278 (0.0397)	--	0.1755* (0.0392)	--	-0.0022 (0.0028)	80.91	2.036+
3.3	Linear	-6.32	0.0119 (0.0440)	--	--	0.1848* (0.0513)	0.0054 (0.0046)	76.56	1.594+
3.4	Linear	-2.60	0.0223 (0.0396)	--	0.1297** (0.0551)	0.0761 (0.0651)	0.0017 (0.0044)	82.33	2.024+
3.5	Linear	-9.70	0.0490 (0.0476)	-0.0214 (0.0212)	0.1524** (0.0595)	0.0832 (0.0654)	0.0037 (0.0048)	83.39	1.804
3.2	Logarithmic	1.8710	0.1057 (0.1428)	--	0.7421* (0.1832)	--	-0.1806 (0.2552)	81.75	1.909+
3.3	Logarithmic	0.1809	-0.1529 (0.1594)	--	--	0.7227* (0.2545)	0.1502 (0.4130)	75.9	1.583+
3.4	Logarithmic	0.2218	0.0246 (0.1455)	--	0.5923* (0.1981)	0.3894*** (0.2396)	0.2147 (0.3447)	84.21	1.998+
3.5	Logarithmic	0.0110	0.0823 (0.1673)	-0.0733 (0.1004)	0.6686* (0.2264)	0.4382*** (0.2519)	0.3599 (0.4021)	84.72	1.79

* Significant at 99% level.

** Significant at 95% level.

*** Significant at 90% level.

\+ The hypothesis of no serial correlation is accepted.

obtain more conclusive results for the remaining equations, models 3.1 to 3.5, except for 3.2, were retested with the variables defined in the form of first differences. The results are presented in Table 4.4. This test was not particularly successful in that all the tests for autocorrelation were inconclusive. The highest explained variation (R^2) was only 64.3 percent although in each case the application of the F-test indicated that the coefficient of determination was significant at the 95 percent level.

The coefficients for the cotton price index and income variables were significant at the 95 and 99 percent levels, respectively. The estimated coefficient for the cotton price index retained its positive sign, and the income coefficients were positive. The effect of the non-cellulosic fibres price variable was almost negligible while that of the cellulosic fibres price index was considerably reduced (see Tables 4.1 and 4.3).

Results of Models 3.1 to 3.5, Using Annual Data, 1956-1969

A careful inspection of the data in Table 3.2 reveals a rapid adoption of non-cellulosic fibres especially since the mid-fifties. This increase has been at the expense of all other fibres, particularly cotton. This increase may be partly due to the adaptability of non-cellulosic fibres and also to the feature that their prices have been reduced

TABLE 4.4

RESULTS OF MODELS 3.1, 3.3, 3.4 AND 3.5, USING FIRST DIFFERENCES OF THE VARIABLES, 1948-1969

Equation	Model Form	Estimated Coefficients						R^2	Durbin-Watson Statistic[1]
		β_0	β_1	β_2	β_3	β_4	β_5		
3.1	Linear	-1.96	0.0680** (0.0306)	--	--	--	0.0325* (0.0079)	54.46	1.34
3.3	Linear	-1.91	0.0667** (0.0314)	--	--	0.0288 (0.0620)	0.0332* (0.0082)	55.0	1.366
3.4	Linear	-1.71	0.0691** (0.0304)	--	0.0944*** (0.0642)	0.0091 (0.0615)	0.0298* (0.0082)	60.07	1.286
3.5	Linear	-1.74	0.0572** (0.0309)	0.0182*** (0.0131)	0.0693 (0.0651)	0.0087 (0.0599)	0.0293* (0.0080)	64.34,	0.959

[1] All tests are inconclusive.

* Significant at 99% level.

** Significant at 95% level.

*** Significant at 90% level.

considerably over time. Non-cellulosic fibres have been extensively used in women's apparel and industrial uses, and are gaining ground in the household furnishing end-uses. Table 2.6 demonstrates this marked gain by non-cellulosic fibres in the market share since the mid-fifties.

The estimated coefficients of the non-cellulosic fibre price variable in the previous analyses over the period from 1947 to 1969 were positive, as would be expected of a substitute commodity. However, non-cellulosic fibres, especially polyester, which is the major non-cellulosic fibre, are used in blends with other fibres in many end-uses. Cotton is one of the major blending fibres. This feature suggests that a complementary relationship may also apply. It was thought that the effects of non-cellulosic fibre competition and of a possible complementary relationship in blending might be more appropriately analysed over the period from 1956 to 1969. Models 3.1 to 3.5 were, therefore, re-tested over this shorter period. The results are presented in Table 4.5.

The results of the linear formulations of the formulations are of interest. First, in all cases, the estimated coefficient for the cotton price variable had a negative sign, as expected from demand theory. This coefficient was significant at the 95 percent level. Secondly, the coefficient for the non-cellulosic fibre price index also had a negative sign which suggests that cotton and non-cellulosic fibres are complements. This result may reflect the effect

TABLE 4.5

RESULTS OF MODELS 3.1, 3.2, 3.3, 3.4 AND 3.5, USING ANNUAL DATA, 1956-1969

Equation	Model Form	Estimated Coefficients						R^2	Durbin-Watson Statistic[1]
		β_0	β_1	β_2	β_3	β_4	β_5		
3.1	Linear	53.73	-0.1129** (0.0429)	--	--	--	-0.0104* (0.0030)	62.1	2.0
3.2	Linear	45.51	-0.0987** (0.0508)	--	0.0544 (0.0951)	--	-0.0096* (0.0034)	63.4	1.984
3.3	Linear	119.97	-0.1326* (0.0403)	--	--	-0.3017*** (0.1677)	-0.0287* (0.0105)	72.12	2.826
3.4	Linear	115.83	-0.1281** (0.0505)	--	0.0153 (0.0913)	-0.2933*** (0.1844)	-0.0280** (0.0120)	72.21	2.773
3.5	Linear	107.62	-0.1085** (0.0568)	0.0248 (0.0302)	0.0443 (0.0997)	-0.3037*** (0.1887)	-0.0269** (0.0123)	74.65	2.384
3.1	Logarithmic	1345100	-0.4880* (0.1734)	--	--	--	-1.1587* (0.3177)	63.95	2.09
3.2	Logarithmic	964000	-0.4779** (0.2230)	--	0.0354 (0.4451)	--	-1.1421* (0.3946)	63.97	2.074
3.3	Logarithmic	77570000	-0.5168* (0.1901)	--	--	-0.2255 (0.4694)	-1.5415*** (0.8628)	64.85	2.17
3.4	Logarithmic	1106900000	-0.5642** (0.2893)	--	-0.1295 (0.5689)	-0.3052 (0.6075)	-1.7376 (1.2549)	65.08#	2.279
3.5	Logarithmic	280760000	-0.4835*** (0.3162)	0.1220 (0.1620)	-0.00004 (0.6097)	-0.4035 (0.6381)	-1.6977 (1.2915)	67.69#	2.023

[1] Test tables not available for n < 15.

* Significant at 99% level.

** Significant at 95% level.

*** Significant at 90% level.

\# R^2 not significant at 95% level.

of polyester and nylon blending with cotton. This coefficient was only significant at the 90 percent level. The estimated coefficient for the income variable was significant at the 95 percent level or higher and was still negative.

In this set of equations, the income variable was the major explanatory variable, closely followed by the cotton price index. Between them, these accounted for 62 percent of the total 74.65 percent explained variation in the consumption of cotton over the period from 1956 to 1969 (equation 3.5). The cellulosic fibre price index, which was an important contributor to the explained variation when the whole study period was analysed, was almost negligible in this regard for the shorter period. The coefficient of this variable was not significant.

These results tend to imply that the competition for cotton is basically from non-cellulosic fibres.

The double logarithmic formulation did not improve the results. In two equations, 3.4 and 3.5, the F-test indicated that the multiple correlation coefficient (R^2) was not significant at the 95 percent level.[1] In addition, the negative sign for the cellulosic fibre price index is difficult to explain.

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[1] The 95 percent level was used in all cases to test for the significance of the multiple correlation coefficient.

Implications of the Signs on the Estimated Coefficients: Analysis of Annual Data

The positive sign on the cotton price coefficient initially appears to be anomalous from the point of view of demand theory. It implies an "upward sloping" demand curve and suggests that cotton is "Giffen" good. For this to be the case, economic theory requires that the good be an inferior good whose income effect is sufficiently strong to outweigh the substitution term of the Slutzky relation. In fact, this analysis did suggest that cotton might be an inferior good. The features of a positive price coefficient and a negative income coefficient are confirmed by other studies of United States fibre consumption.[1]

The relatively small size of the coefficients of the cotton price variable tend to suggest that price is not of major influence in the consumption of cotton. This feature may arise from the fact that wholesale prices for cotton in the United States are subject to price supports and thus are institutionally administered. This feature may have tended to make cotton relatively unresponsive to market conditions of supply and demand. In addition, cotton and cotton-blend products are extensively used in every day clothing and household furnishings. This feature may tend to make cotton more or less a necessary commodity, and,

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[1] L.F. Ward and G.A. King, Interfiber Competition with Emphasis on Cotton; and J.R. Donald et al., Demand for Textile Fibers.

therefore, relatively unresponsive to price changes.[1]

The results of the analysis of annual data for the period from 1956 to 1969 suggest that although cotton is an inferior commodity, it is not a "Giffen" good as suggested by the "upward sloping" demand curve obtained from the analysis of annual data over the 1947 to 1969 period. The coefficients of the cotton price variable for the shorter period were significant and relatively larger than those obtained from the analyses of annual data over the longer period. The coefficients for the cotton price variable for the period from 1947 to 1969 were not significant.

The results from the foregoing analyses of annual data suggest that studies based on more recent years may obtain more realistic conclusions than those based on data for earlier periods. Such studies would more accurately account for the influence of non-cellulosic fibres on the consumption of cotton.

Results of Models 3.5 and 3.11, Using Quarterly Data, 1954-1967 and 1963-1967

The analysis of quarterly data was done in order to gauge the possible influence of changes in prices and income

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[1] Kenneth A. Lewis, "An Econometric Analysis of the Market for Textile Fibers," American Journal of Agricultural Economics, Vol. 54, No. 2 (May, 1972).

within each year on cotton consumption. The parameters were estimated by refitting equations 3.5 and 3.11 with the quarterly data. Both income and the price indices were lagged six months to allow for a lag in consumer response. The results are given in Table 4.6 for both the 1954 to 1967 and the 1963 to 1967 periods. The latter period was used in an effort to gauge possible effects of non-cellulosic fibres on the consumption of cotton after these synthetics had become well established in the textile fibre market and had started to move into most of the major end-use markets.

The results from model 3.5 indicated that the coefficients for the wool and non-cellulosic fibre price and the income variables were not significant. The cellulosic fibre price coefficient was significant for the period from 1954 to 1967 at the 99 percent level, while that for cotton price was significant at the 95 percent level.

When the dummy variables representing possible quarterly changes in cotton consumption were included in the analysis (equation 3.11),[1] the coefficients for own-price and the cellulosic price variables were significant at the 95 and 99 percent levels respectively. The cellulosic fibre price index was the major explanatory variable. It accounted for 38.85 percent of some 66 percent total explained variation in the consumption of cotton. Equations

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[1] The inclusion of the dummy variables was significant at the 95 percent level using the F-test.

TABLE 4.6

RESULTS OF MODELS 3.5 AND 3.11, USING QUARTERLY DATA, 1954-1967 AND 1963-1967

Period	Equation	Estimated Coefficients						Quarterly Dummy Variable Coefficients			R^2	Durbin-Watson Statistic
		β_0	β_1	β_2	β_3	β_4	β_5	γ_1	γ_2	γ_3		
1954-1967	3.5	39.71	-0.0016** (0.0009)	-0.00002 (0.0003)	0.0036* (0.0011)	0.0011 (0.0009)	-0.0061 (0.0053)	--	--	--	50.67	1.097++
	3.11	39.44	-0.0015** (0.0008)	-0.00003 (0.0002)	0.0038* (0.0010)	0.0009 (0.0008)	-0.0064 (0.0045)	-3.4421* (1.0716)	-0.1740 (1.0791)	1.6092*** (1.0876)	66.08	0.698++
1963-1967	3.5	56.21	-0.0034* (0.0010)	0.0002 (0.0013)	-0.0023 (0.0037)	0.0039 (0.0055)	0.0061 (0.0211)	--	--	--	54.78	1.974+
	3.11	52.36	-0.0036* (0.0006)	0.0010 (0.0008)	-0.0047** (0.0022)	0.0045*** (0.0031)	0.0127 (0.0120)	2.8241* (0.9583)	2.2500** (0.9439)	-1.9567** (0.90)	89.18	2.535+

* Significant at 99% level.

** Significant at 95% level.

*** Significant at 90% level.

\+ The hypothesis of no serial correlation is accepted.

++ The hypothesis of no serial correlation is rejected.

3.5 and 3.11 showed evidence of positive auto-correlation.

The results from equation 3.5 for the period from 1963 to 1967 showed that only the coefficient for the cotton price was significant and that only 54.8 percent of the variation in cotton consumption was explained by the variables used. However, inclusion of the dummy variables (equation 3.11) yielded improved results. In equation 3.11, except for the coefficients of the wool price and income variables, all estimated coefficients were significant at the 90 percent level or higher. The explained variation increased by 34.48 to 89.18 percent. The cotton price index, the third-quarter dummy variable and the non-cellulosic fibre price variables were the major explanatory variables. They accounted for 32.7, 24.5 and 21.3 percent, respectively, of the total explained variation in the consumption of cotton.

The coefficient of the non-cellulosic fibre price variable was significant at the 90 percent level and this variable accounted for 21.3 percent of the explained variation. This suggests that non-cellulosic fibres were more of a major influence on the consumption of cotton in the later years of the study than during the whole study period. This confirms the results obtained from the analysis of the annual data for the period from 1956 to 1969. However, the feature of complementarity between cotton and the non-cellulosic fibres was not indicated in this analysis of quarterly data since the coefficients for the non-cellu-

losic fibre price index are positive.

The significant quarterly dummy variables suggest that there are strong seasonal demand shifts. This feature may be a result of the changes that occur from winter to summer clothing which is reflected in the purchases of raw cotton at the mill level.

Implications of the Signs on the Estimated Coefficients: Analysis of Quarterly Data

The coefficient for the cotton price variable was negative in all cases. This feature suggests that cotton is not a "Giffen" good as suggested by analyses of annual data. However, the coefficient of the income variable was negative for the period from 1954 to 1967, again suggesting that cotton is an inferior commodity. On the other hand, this coefficient was positive for the period from 1963 to 1967. The negative signs for the wool and cellulosic price coefficients are difficult to explain since these fibres are not generally blended with cotton.

The results from the analyses of annual data for the period from 1956 to 1969 and of quarterly data for the period from 1954 to 1967 are more realistic than those obtained from the analyses of annual data for the whole study period (1947 to 1969). The cotton price coefficient was negative for the shorter period, as expected from demand theory. Although the coefficient for the income

variable was still negative, thus suggesting that cotton is an inferior good, the negative cotton price coefficient disproves the apparent "Giffen" good conclusion suggested by the "upward sloping" demand curve obtained from the analyses of annual data for the whole study period.

The Estimated Elasticities

Table 4.7 presents the elasticities calculated from the foregoing analyses. These are in each case based on those estimated coefficients that were significant at the 90 percent level or higher, except in the case of the wool and income variables from the analysis of quarterly data. In this case, the level of significance was 80 percent.

The results indicate that the long-run own-price elasticity of demand is substantially larger than that for the short-run. The same applies to the cross-price elasticities. The level of the estimated own-price elasticity of demand implies that the consumption of cotton is not very responsive to price changes in the long-run and is extremely unreponsive to price changes in the short-run. These results imply that the consumption of cotton is price inelastic in both the short-run and the long-run. Lewis[1] and Waugh reached similar conclusions regarding the own-

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[1] K.A. Lewis, "An Econometric Analysis of the Market for Textile Fibers".

[2] F.V. Waugh, Demand and Price Analysis.

TABLE 4.7

SHORT-RUN AND LONG-RUN PRICE AND INCOME ELASTICITIES OF DEMAND FOR COTTON[1]

	Equation	Model Form	Elasticities				
			P_1	P_2	P_3	P_4	Y
Short-Run	3.9	Linear	-0.024	0.017	0.064	0.056	-2.657
Long-Run	3.2	Logarithmic	--	--	0.773	--	--
	3.3	Linear	--	--	--	0.790	--
	3.5	Linear	-0.404	0.093	--	--	-2.542

[1] Based on coefficients significant at 90% and over except for the wool and income variables for the short-run, which were based on coefficients significant at the 80% level.

price elasticity of demand.

The estimated income elasticities over the short-run and long-run periods are not greatly different from each other and are relatively large and negative. This feature implies that cotton is an inferior good, and a good which is fairly responsive to income changes both in the short-run and long-run. The one exception occurred in the analysis of quarterly data over the period from 1963 to 1967, but the coefficient here was not highly significant.

Limitations of the Analysis

Data

The demand for raw fibres by the textile industry can be viewed as a demand for factors of production. The purchase of fibres would, therefore, be expected to be a function of factor prices, product prices, and the given level of technology. The inclusion of product prices would reflect the fact that mill demand for fibres is derived from the retail demand for consumer goods. However, product price data series were not available for this study. This limited the scope of the study. In addition, data series for very recent years were not available.

Autocorrelation

The results of equation 3.1 indicated a problem of positive auto-correlation, and the other estimating equa-

tions, except for equation 3.2, had inconclusive tests for auto-correlation. An attempt to correct this problem by transforming the variables into first differences was not successful. All tests for auto-correlation were inconclusive. This implies that serially correlated disturbances could not be eliminated.

Multicollinearity

The use of time series data on fibre price indices and income raised the question of correlations between these explanatory variables. Tables 4.8 and 4.9 present the simple correlation coefficients between the explanatory variables, including time. A number of these correlations are relatively high. These include the correlations between the non-cellulosic fibres price variable and income (0.96); between income and time (0.89); and between the cotton price variable and income (0.89). These levels suggest that extreme multicollinearity may apply. This may explain the relatively high standard errors of the coefficients of the cotton and non-cellulosic fibres price variables. The estimated coefficients on these variables (and, in some cases, on the income variable) were not significant in many cases.

In addition, as pointed out earlier, the prices of synthetic fibres used in the study were only approximations of the actual trading prices. This feature could have resulted in errors in the observations, which is a source

TABLE 4.8

SIMPLE CORRELATIONS FOR LINEAR AND LOGARITHMIC FORMULATIONS

	Price of	Wool	Cellulosics	Non-Cellulosics	Income	Time
Linear	Cotton	0.61	0.68	0.86	0.89	0.75
	Wool	--	0.62	0.59	0.46	0.67
	Cellulosics	--	--	0.81	0.68	0.83
	Non-Cellulosics	--	--	--	0.96	0.87
	Income	--	--	--	--	0.89
Logarithmic	Cotton	0.59	0.56	0.89	0.89	0.65
	Wool	--	0.60	0.60	0.50	0.34
	Cellulosics	--	--	0.75	0.72	0.83
	Non-Cellulosics	--	--	--	0.98	0.83
	Income	--	--	--	--	0.87

TABLE 4.9

SIMPLE CORRELATIONS FOR THE LAGGED VARIABLE MODEL

	Price of	Wool	Cellulosics	Non-Cellulosics	Income
Linear	Cotton	0.58	0.60	0.84	-0.88
	Wool	--	0.61	0.54	-0.43
	Cellulosics	--	--	0.82	-0.69
	Non-Cellulosics	--	--	--	-0.94
Logarithmic	Cotton	0.55	0.55	0.88	-0.89
	Wool	--	0.59	0.56	-0.46
	Cellulosics	--	--	0.77	-0.73
	Non-Cellulosics	--	--	--	-0.96

of multicollinearity.

This problem of multicollinearity may have been alleviated if the non-cellulosic fibre price and the income variable could have been treated as one explanatory variable. Alternatively, one of the highly correlated variables could have been omitted from the analysis on the assumption that one of these variables would explain the influence of the other. However, the study was intended to measure the effect of all these explanatory variables on the consumption of cotton in the United States. Therefore, all explanatory variables, except time, were retained.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

This study focused on an analysis of the demand for cotton in the United States. World trends in production, consumption, and trade in cotton in relation to the other major fibres were outlined for the period from 1951 to 1974. The consumption of cotton in the United States relative to these other fibres was examined for the period from 1947 to 1969. Special emphasis was placed on the competition against cotton from non-cellulosic fibres which has been particularly evident since the mid-fifties.

Econometric analyses were applied to the estimation of the effects of changes in the levels of fibre prices and income on the per caput mill consumption of cotton in the United States. This analysis used both linear and double-logarithmic formulations of the single-equation multiple regression models outlined in Chapter III. The results from this regression analysis were used to estimate price and income elasticities of demand for cotton applying in both short-run and long-run time periods in the United States.

The analysis of annual data for the whole study

period (1947 to 1969) suggested that income and cellulosic fibre prices were the most important variables in explaining the variation in the consumption of cotton in the United States. These two variables accounted for between 50 and 85 percent of the total explained variation in the consumption of cotton in the various estimating equations. In most cases, the coefficient for the cotton price variable was positive and not significant. The coefficient for the income variable was negative and generally significant. However, this coefficient was positive and highly significant in the analysis of first differences of the variables, and generally significant when time was included as an explanatory variable. The positive signs of the own-price coefficients and the negative signs of the income coefficients were contrary to expectation. These features suggested that cotton is not only an inferior commodity but possibly a "Giffen" good. However, as noted above, the own-price coefficients, though positive, were not significantly different from zero. Auto-correlation and multi-collinearity posed serious problems in the analysis of both annual and quarterly data and may have adversely affected or biased the results.

In the analysis of annual data for the more recent and shorter period between 1956 to 1969, income and the price of cotton were the most important variables in explaining variations in the consumption of cotton over this period. These two variables accounted for 63 percent

of the explained variation in the consumption of cotton from 1956 to 1969. The estimated own-price coefficient was negative (unlike the results of the analysis of annual data from 1947 to 1969). This coefficient was significant at the 95 percent level of confidence. The negative sign on the own-price coefficient indicated that from 1956 to 1969 the consumption of cotton was inversely related to its own-price and that cotton was not a "Giffen" good as might be suggested by the results of the analyses of annual data over the period from 1947 to 1969. However, the negative income coefficient indicates that cotton is an inferior good. The estimated coefficient on the non-cellulosic price variable was negative which indicates that cotton and non-cellulosic fibres are complements. This feature confirms the observed importance of the blending relationship between cotton and non-cellulosic fibres, particularly polyester and nylon, in apparel and some household furnishings end-uses. Durbin-Watson statistic limits for testing for auto-correlation were not available for this shorter period.

An analysis of quarterly data was applied to the period from 1954 to 1967. The results from this analysis showed that there are significant seasonal demand shifts in the consumption of cotton in the United States. The own-price coefficient was negative and significant, but relatively small. The income coefficient was still negative but not significant in the analysis of quarterly data.

The estimated elasticities were calculated from those coefficients that were significant at the 90 percent level of confidence or higher, except in the case of the short-run income and wool cross-price elasticities where the level of significance was 80 percent. The own-price elasticity of demand indicates that the demand for cotton in the United States is highly price inelastic in the short-run. Although more elastic than in the short-run, the demand for cotton was still relatively inelastic in the long-run (as calculated from the analysis of annual data from 1956 to 1969). The estimates of own-price elasticity of demand for cotton varied between -0.05 for the short-run to -0.40 for the longer-run annual periods. The estimated long-run elasticity of demand for cotton differs from the estimates obtained by Waugh[1] and Lewis.[2] Their studies suggested that the demand for cotton in the United States was elastic in the long-run. Possible reasons for this difference could be the difference in the study periods and the influence of support programmes. The study by Lewis covered a longer period of time (from 1920 to 1970) than this study. Waugh's study was done before the main support programmes of acreage allotments, diversions, and price support were started.

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[1] F.V. Waugh, Demand and Price Analysis.

[2] K.A. Lewis, "An Econometric Analysis of the Market for Textile Fibers".

The estimates of the income elasticity of demand for cotton from this study indicate that cotton is an inferior good both in the short-run and long-run time periods. The estimates of this elasticity were -2.65 for the short-run and -2.54 for the long-run period. The conclusion that cotton is an inferior good has significant implications for the producers of this crop and, consequently, for government production and trade policies.

Conclusions

Over the period from 1951 to 1974, aggregate world cotton consumption showed a slight upward trend. However, per caput consumption has shown a declining trend, particularly in the United States, Western Europe and Japan. The declining trend in per caput consumption of cotton in the United States is particularly evident in women's clothing, men's hosiery, household furnishings, and industrial uses. It is also reflected in a general decline in the level of cotton imports into some of the major cotton consuming countries, especially Western Europe. However, the Soviet Union, China and some developing countries have shown an increasing trend in the consumption of cotton.

The market for cotton is increasing very slowly and cotton's share of the world fibre market is becoming smaller due to competition from synthetic fibres. This situation indicates that cotton growing countries may need

to find new markets for their cotton or encourage production of other crops. This problem of the slow growth in world cotton consumption is particularly severe for the cotton producing developing countries. These countries account for about 60 percent of the world trade in cotton. A slowly growing world cotton market is of particular concern to these countries since many of them have few alternative profitable crops.

One major reason for the decline in the per caput consumption of cotton appears to have been the tremendous increase in the production and consumption of synthetic fibres, particularly non-cellulosics. The increased acceptance of synthetic fibres arises partly from their adaptable nature and also, possibly, from prestige motives and "easy care" attributes that encourage their use as the level of consumer income increases.

The results from this study and other related studies show that the consumption of cotton is fairly unresponsive to price changes. This feature suggests that cotton is, to a certain extent, a necessary commodity. However, cotton lacks some technical qualities, such as strength and adaptability, which are possessed by synthetic fibres. The feature that the consumption of cotton is fairly unresponsive to price changes tends also to imply that the competition between fibres is not based entirely on price but on other factors, the most important of which may be the technical qualities of the fibres. However, it should be noted that

though the coefficient on the own-price variable were generally relatively small and not significant in the analyses using annual data for the period from 1947 to 1969, analysis of the shorter period from 1956 to 1969, resulted in relatively larger and significant own-price coefficients. This difference suggests that price has become a significant factor in the demand for cotton.

The United States and many other cottong growing countries have support programmes for cotton. These programmes, which support a commodity whose market is only growing slowly, may encourage over-production, and consequently, escalate the current problem of increasing world cotton stocks.

An observed feature of the trading policies of many developed nations is the existence of relatively high trade barriers. Quotas, "voluntary restrictions" on imports, and relatively high tariffs apply to the importation of cotton products into most developed countries. There is a tendency for the tariff rates which are applied to be set so that these rates increase as the level of processing increases. Thus, the nominal rates are inadequate in reflecting the actual extent of protection afforded the local processing industry. In many instances the effective rates of protection have been found to be much greater than the nominal rates. The immediate result of such measures is to curtail the importation of processed and finished cotton goods. This feature has tended to limit exports of

processed goods by developing countries, and thus has adversely affected the extent of industrialization in these countries. These features are not in accord with the principle of comparative advantage.

Recommendations

Major recommendations arising from this study are in the fields of research and promotion and production and trade policies. Several recommendations relating to the need for further research are also made.

Research and Promotion

The feature that in many end-uses cotton's major role is as a blended fibre with non-cellulosic fibres leads to a requirement for improved technology in the processing of cotton. Since the early 1960's, cotton and polyester or nylon have been blended in a general ratio of 35 to 65[1] percent, particularly in apparel and some household furnishing uses. For most fibre blends on the textile market, optimum percentages have been established for at least one of the fibres involved. For example, it has been fairly well agreed among textile manufacturers that in blends of polyester and cotton, the optimum percentage of polyester

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[1] Rayon Publishing Corporation, Modern Textile Magazine, Vol. 44, No. 1 (New York: Rayon Publishing Corporation, January, 1963).

should range between 50 to 65 percent.[1] The 65:35 polyester/cotton blend which is basically used in light and medium weight fabrics, and the 50:50 dacron/cotton blending which is used in suiting weight fabrics were recommended by the DuPont Company on the basis that these rates "assure satisfactory performance of the fabric and maintain a good fibre image".[2] However, if fabric producers are willing to use generic names only, they can set their own blend levels provided they meet minimum standards to compete on the retail market.[3] However, it appears that textile companies have been unwilling to use a higher cotton/polyester blending rate than that recommended by DuPont. Therefore an effort to improve this relatively smaller role played by cotton in blending should be researched. In addition, such research should also be directed towards improving the quality of cotton products in order to lessen cotton's apparent "inferior good" status in an attempt to lead consumers to perceive this as a prestige fibre. Technological research in this area should be supported by promotion to reach this end.

These efforts would necessitate the increase of funds

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[1] Majory L. Joseph, Introductory Textile Science (New York: Holt, Rinehart and Winston, 1972), p. 293.

[2] Normal Hollan and Jane Saddler, Textiles, 3rd Edition (New York: The Macmillan Press, 1968), p. 87.

[3] Ibid.

already provided in the United States under the 1966 Cotton Research and Promotion Act and the 1970 Agricultural Act. Similar programmes should be pursued in other countries. An international effort to foster research and promotion of wool in major consuming countries is conducted and funded by the major wool exporting countries. A similar cooperative effort by cotton producing and exporting nations would be of benefit.

It should also be noted that the availability, cost, and prices of non-cellulosic fibres are dependent on oil supplies. Their future production and, therefore, their use are dependent on the availability and price of oil. Increasing oil prices may provide a price advantage for cotton. Cotton's natural advantages should, therefore, be encouraged by market research and promotion in existing and new end-uses.

Production Policy

The United States and many other cotton growing countries have support programmes for cotton. However, the total consumption of cotton is increasing only slightly, particularly in Western Europe and the United States. There is, therefore, a strong argument that support programmes which increase the level of cotton prices should be removed to allow cotton to compete on the basis of the market forces of supply and demand. The removal of support programmes would eliminate marginal cotton growers, improve

efficiency in the production of cotton, and help reduce the level of world cotton stocks. The released funds could be diverted to research and promotion.

Trade Policy

Many developed nations use trade barriers to limit imports of relatively cheap textile products from developing countries. Such measures are undesirable in international trade since they contravene the principle of comparative advantage. Tariffs and non-tariff barriers should either be removed or substantially reduced to allow a freer movement of commodities, particularly of processed and finished goods. Such a change could provide some encouragement to industrialization in the developing nations. In addition, in cases where tariffs are still applied, effective rates of protection rather than nominal rates should be used to indicate the extent of protection afforded a local industry. Such a change should, in turn, lead to an adjustment of nominal tariff rates so that lower effective rates of protection apply.

Further Research

The analysis of the annual data for the period from 1956 to 1969 tended to give different results from those obtained from the analyses of annual data for the period from 1947 to 1969. This suggests that there have been structural changes in the demand for cotton. Data since

1969 were not available. Further studies should develop and use more recent data to more accurately gauge the effect on the consumption of cotton of non-cellulosic fibres and their competitive and blending relationship with cotton. In addition, efforts should be made to include accumulated stocks and the prices of final products as separate explanatory variables affecting the consumption of cotton. Inclusion of these two variables would make the models more dynamic and emphasize the derived demand nature of the demand for textile fibres at the mill level. Further work should be done to measure the effectiveness and ways to improve the effectiveness of the present research and promotion programmes for cotton.

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